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CONTENTS

	PAGE
Co-operation in World Affairs	131
British and German University Enrolments	133
Biological Aspects of Health	134
Hamilton and Geometrical Optics. By Prof. H. T. H. Piaggio	135
Presentation of Physical Chemistry. By S. G.	136
Geology and Archæology of the Hadhramaut, South-west Arabia. By Miss G. Caton-Thompson	139
Modern Views in Physics. By Prof. C. G. Darwin, F.R.S.	143
Obituary Notices:	
Mr. W. M. Mordey. By A. R.	144
News and Views	145
Research Items	171
Fourth International Locust Conference. By B. P. U.	174
Numerical Changes in the German Student Body. By Dr. E. Y. Hartshorne, jun.	175
The Constitution of Starch	177
River Tees Survey	177
The Study of Genetics	178
Science News a Century Ago	179
University Events	179
Societies and Academies	180

SUPPLEMENT:

Letters to the Editor:

Ultracentrifugal Examination of Serum from the Lower Classes of Vertebrates.—Prof. The Svedberg and Kjell Anderson	147
A New Natural Colouring Matter of the Naphthalene Group.—J. R. Price and Prof. R. Robinson, F.R.S.	147
Hæmocuprein, a Copper-Protein Compound of Red Blood Corpuscles.—Dr. T. Mann and Prof. D. Keilin, F.R.S.	148
A Hæmoglobin from Bile Pigment.—Dr. R. Lemberg, J. W. Legge and W. H. Lockwood	148
Isolation of a Flavin-Protein Compound from Milk.—H. S. Corran and Dr. D. E. Green	149
A New Enzyme of the Glycosidase Type.—Dr. Donald H. Hall	150
Quantitative Measurement of Vitamin B_1 by the Thiochrome Reaction.—Dr. H. G. K. Westenbrink and Dr. J. Goudsmit	150
Occurrence of Acetylcholine in Nervous Tissue of Crustaceans and its Effect on the Crab Heart.—Dr. J. H. Welsh	151
Dormant Life of Tumour Cells in the Animal Body.—Dr. F. Ellinger	151
A Simple Respirometer for Small Animals.—Edward G. Boettiger	151
Substitution of Cysteine for Protohæmin as the 'X' Factor for Growth of *H. influenzæ*.—Thomas L. Snyder and R. H. Broh-Kahn	153
Composition of the Aerial Insect Fauna up to 300 ft.—John A. Freeman	153
A New Test Plant for Potato Virus Y.—Dr. R. W. G. Dennis	154
The Florisbad and Taungs Skulls.—Prof. M. R. Drennan	154
Kymograph Studies of Physiological (Respiratory) Concomitants in Two Types of Attentional Adaptation.—Dr. Trigant Burrow	156
Chromosome Structure.—Prof. R. R. Gates, F.R.S. and G. N. Pathak	156
Distribution of Crossing-Over in the Chromosomes of *Drosophila*.—Dr. K. Mather	157
Control of a Species-Difference by Means of a Difference in an Inductor.—Curt Stern	158
Neutral Particles in Cosmic Radiation.—N. Arley and Dr. W. Heitler	158
Viscosity of Air and the Electronic Charge.—Prof. H. R. Robinson, F.R.S.	159
Waves Associated with Moving Corpuscles.—W. E. Benham	160
A Useful Statistical Test.—H. J. Buchanan-Wollaston	160
Passivity of Iron to Natural Waters.—Dr. U. R. Evans	160
Negative Thixotropy.—Dr. G. S. Hartley	161
Crystal Structure of Succinic Acid.—(The late) H. J. Verweel and Carolina H. MacGillavry	161
A New Method of Resolving a Racemic Compound.—Prof. G. Karagunis and G. Coumoulos; G. M. Henderson and Dr. H. Gordon Rule	162
Modified Gattermann Reaction: Synthesis of Hydroxy-Formyl-Phenyl-Ketones.—H. A. Shah and Dr. R. C. Shah	163
Long-distance Radio Reception and the *E*-Region of the Ionosphere.—Harry Rowe Mimno	163
Enhancement of the Sodium *D* Lines in the Twilight Sky Light.—René Bernard	164
Use of Non-Conservative Properties of Sea Water to Physical Oceanographical Problems.—H. R. Seiwell	164
Effect of Addition of Calcium on the Biological Value of the Proteins of Indian Diets.—V. Ranganathan and Y. V. S. Rau	165
Biological Fixation of Nitrogen.—Prof. Artturi I. Virtanen and T. Laine	165
Electric Lines of Force.—J. Baxenden	165

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Co-operation in World Affairs

THE annual reports in which the Director of the International Labour Organization surveys world industrial conditions owe their exceptional value not only to the large resources of knowledge upon which they draw, their wide outlook and measured but unequivocal judgments, but also to the admirable way in which Mr. H. B. Butler, avoiding excessive occupation with the detail of the work of the Organization, has given a balanced estimate of tendencies and changes in the economic and industrial situation, for which the scientific worker no less than the economist or statesman should be grateful. Mr. Butler's latest and last report* is no exception, and his review of current conditions is followed by an appreciation of the changed distribution of economic power in the world which should facilitate judgment as to the extent or severity of the recession in trade.

On the purely economic side, Mr. Butler is indeed fairly hopeful. Notwithstanding the continued political unrest and the hindrances deliberately put in the way of international trade, the world has struggled back to a prosperity which if anything surpasses the level of well-being in 1929. In spite of the severity of the American depression, he anticipates an early resumption of activity and sees some signs of greater international co-operation in trade and in currency matters.

This optimism is, however, restrained, and against this prosperity Mr. Butler sounds two notes of warning. First, the present is an unstable prosperity, and in part issues precariously from vast expenditure on armaments and the outlay of borrowed money. Peace as well as prosperity depend largely on international trade. The effort of nations to live more and more to themselves, the pursuit of policies which make it imprudent to be dependent on other countries for essential supplies, and consequent disengagement so far as possible from a world economic system—these all menace such comparative prosperity as we still enjoy. While the energies of every great nation are primarily devoted to war, economic development encased in a military strait-jacket, and social welfare subordinated to the construction of guns, warplanes and battleships, expectation of the future must be tempered with anxiety rather than hope.

Secondly, Mr. Butler contrasts what prosperity at present exists with what might be enjoyed in a different atmosphere. It is certain that genuine prosperity might have been more abundant and the prospects of endurance greater had not an excessive portion of the wealth of almost every country been diverted to war purposes. As the International Chamber of Commerce recognized at Berlin last year, in all countries the rapid progress of science and invention and modern methods of production and transport would permit of the standards of living being greatly improved, provided the world would co-operate in rational distribution. In an atmosphere of autarchy or national competition, there is no prospect of attaining the standard of feeding, clothing, health, housing, working hours or leisure which the vast technical progress of this century has brought within our grasp.

It is well therefore to be reminded by this sober review that in spite of all the national experiments, many of which have achieved a considerable measure of success, a high standard of living cannot be achieved by national effort alone. No country can realize its full economic and social potentiabilities except as a part of the world

*International Labour Office. Twenty-fourth Session, Geneva, 1938. Report of the Director. Pp. 81. (Geneva: International Labour Office.) 1s. 6d. paper, 2s. 6d. cloth.

community. Failure to recognize this truth is not merely the gravest threat to prosperity everywhere. The progressive subordination of the whole national life and the activity of every individual to the requirements of the State, the cramping and distortion of individual freedom and economic expansion are already blocking some of the main lines of social advance and now threaten to sap the social edifice which this generation has raised.

The sombre picture which Mr. Butler gives is one which requires careful consideration by all thinking men, including scientific workers as such. Only by a determined effort can the present progressive deterioration be averted, and that effort is now demanded in the interests of science itself. Moreover, though science cannot take more than a small part of the blame for mankind's failure to utilize scientific knowledge to the fullest advantage in service of man's daily needs or for the use of scientific knowledge for destructive purposes, scientific workers are also citizens, and as such must accept the greater responsibilities which their knowledge and training entail.

It is not, of course, within the scope of Mr. Butler's report to suggest ways and means of securing action. He can only give a warning, and it is one to be heeded by scientific workers. Moreover, the report is not without certain suggestions which merit their special attention. In discussing the question of unemployment, Mr. Butler points out that although in most countries the employment situation was much better in 1937 than at any time since 1929, due partly to demands for war material and the expansion of armed forces, there is in many countries a marked shortage of skilled workers. This is due partly to military requirements, but mainly to the failure to educate a sufficient number of apprentices during the depression. Accordingly it is suggested that the whole question of industrial education and training for industry should be reconsidered.

This is a question with which scientific workers are very closely concerned. Even in regard to the problem of training for technical positions in industry, professional associations cannot be said to have given anything like adequate attention to the many important questions involved. The great demand in mechanized industry for highly trained workers possessing a wide range of technical knowledge cannot be met without their co-operation. Apart altogether from its reaction on the position and efficiency of the scientific worker in industry, the solution of this problem has social aspects at least as important as its effect on industrial efficiency. The provision of such highly trained workers would do something to counteract the ill-effects of the monotony of mechanization which have sprung up with the passing of the craftsmen, and would also make for the mobility of labour and lessen the tendency of specialized work to create men who are unemployable in other capacities.

Here and elsewhere, as in its references to the work on nutrition, the extension of the principle of social insurance, the continued tendency towards shorter hours of work, the report marks signs of progress and opportunities for further advance by international co-operation. The main value of the report lies, however, in the world picture it gives and the clear warning it sounds as to the danger of certain policies which are widely countenanced to-day. No thoughtful reader can fail to recognize the necessity for facing a changed situation and evolving new methods to deal with it. The very expansion of the activities of the International Labour Organization itself to meet the increased need for international co-ordination with the passing of economic *laissez-faire*, the increased importance attached to the problems of agriculture, migration, housing, nutrition, indigenous labour, attest the existence of an immense amount of international co-operation even in these days of anxiety and unrest, and forecast the immense opportunities of development, in many of which scientific workers have their part to play.

Beyond this, the distribution of economic power is shifting. The economic development of the Far East is inevitable, and there is little doubt that Europe will ultimately lose some of its pre-eminence in the economic sphere, a process likely to be accentuated by the division of Europe into groups pursuing different social objectives and working upon different economic principles. Here again are problems to be worked out rather than fought out, and Mr. Butler's survey is pregnant with challenge to commercial and industrial statesmanship.

Ultimately, however, it is the challenge to men of good will everywhere to unite in the task of securing for all mankind the advantages which the achievements of modern technology have put within our grasp that most commends the report. The prostitution of scientific knowledge to destructive purposes and the pursuit of retrograde nationa economic policies threaten the whole social edifice and with it the freedom and

continuity of scientific work itself. For scientific workers, Mr. Butler poses clearly the question whether they are prepared to take up the arduous task with their fellow citizens of evolving means of arresting the drift to disaster, making their own special contributions to the solution of specified technical problems, or by their indifference and neglect allowing the forces of disruption and retrocession to gain strength until scientific workers are overwhelmed with the rest.

British and German University Enrolments

IN another column (p. 175) we print an article on "Numerical Changes in the German Student Body" by Dr. E. Y. Hartshorne of Harvard, author of "German Universities and National Socialism". The main conclusions in Dr. Hartshorne's article may be summarized by saying that the reduction in number of students in German universities and seats of higher learning was approximately 42 per cent between 1932 and 1937, so that where there were a hundred in 1932 there were only fifty-eight in 1937. The process has since continued, and it seems probable that there are now not more than half the number of students in Germany that there were in 1932. Of the survivors, more than a third—approximately 34 per cent in 1937—were students of medicine. The great reductions have been in humanities, in 'pure' science and in law and allied studies. These conclusions naturally suggest an inquiry whether there are similar tendencies, if of a less degree, in the British student body. A preliminary investigation of the returns of the Universities Grants Committee shows that this question must be answered in the negative.

Since the academic year 1933–34, there has been a slight fall in the number of students entering British universities. The changes are of the order which those who administer universities regard as normally associated with fluctuations of prosperity. There is no reason to suppose that they have any permanent or deeply seated social causation. Moreover, within the British student body itself there are only minor fluctuations in the distribution of numbers. The British classifications are scarcely comparable to the German, but, with due reservations, it is possible to construct tentatively a comparative table of student groups in Great Britain and Germany, expressed as percentages of the total enrolment in each country. Such a table can be interpreted, however, only in the light of the enormous absolute fall in the total number of German students.

It will be seen that the highly significant drop, both relative and absolute, in the sciences and in engineering in the greatly diminished German student body has no parallel in the British universities. A distant analogy may be suggested in the rise in the percentage in 'medical studies' in the two countries. The relatively greater attention paid to these by British students is, however, easily explicable by the rise in importance of the social services in Britain and the increased demand for British trained medical men overseas.

PERCENTAGES OF TOTAL ENROLMENT

	1932–33	1936–37
'Agriculture', Great Britain	1·6	1·9
'Agriculture', Germany	1·2	2·2
'Pure Science', Great Britain	16·7	16·3
'Natural Science and Mathematics', Germany	11·1	7·0
'Technology', Great Britain	9·0	9·0
'Engineering', Germany	12·5	11·4
'Medicine', Great Britain	22·4	26·7
'Medical Sciences', Germany	27·9	33·9

So far as foreign students are concerned, the movement in Great Britain is in the opposite direction to that in Germany. The report of the Universities Grants Committee notes that the number of students from overseas in British universities reached in 1936–37 the record figure of 6,792. This is an increase of about 50 per cent over 1932–33. Dr. Hartshorne records a decrease in the number of foreign students in Germany from 6,693 in 1932–33 to 4,768 in 1936–37. The "Universities Year Book of the British Empire" shows the countries of origin of students from abroad in British universities. The numbers from Germany in the six years 1932–33 to 1936–37 were respectively 169, 375, 436, 439, 416, 444. These may be compared with the corresponding numbers of students from Holland: 46, 55, 42, 55, 69, 58; and from France: 80, 73, 81, 78, 76, 50. We leave our readers themselves to judge whether the increase in the number of students from Germany since 1933 is due to an increased recognition of the advantages of study in Great Britain or to the racial and other limitations which are now imposed in that country upon entrance to universities.

Biological Aspects of Health

Biologists in Search of Material

An Interim Report of the Work of the Pioneer Health Centre, Peckham. Pp. 104. (London: Faber and Faber, 1938.) 2*s*. net.

A SMALL company of private individuals established what they described as a "Pioneer Health Centre" in April 1926 in a small house in Peckham, London. It was situated in the middle of a densely populated artisan district, and staffed with a resident medical officer, a social secretary and a housekeeper. Families living in the neighbourhood were invited to join a 'family club' for a small weekly sum, in return for which they were offered a periodic medical and dental overhaul for each individual, a parents' clinic with men and women doctors, ante-natal, post-natal and infant welfare clinics, and to these were added an orthopædic clinic and a children's afternoon nursery. The service offered to each family was advisory. No disease received treatment at the centre. Its objects were inquiry, social and medical investigation, to evoke a desire for health, to detect and direct attention to the beginnings of disease, and to give advice as to how to procure necessary and effective treatment. After several years' experience, an explanatory book was issued entitled "The Case for Action" (1931), and now a report is published, under a rather formidable and ambiguous appellation, of the principal findings.

The document now issued explains the growth and expansion of this interesting and somewhat unusual family club, in and around which various social activities have grown up. The report is concerned with the incidentals of the readjustment and rehabilitation of the sick and the promotion of health. But it necessarily raises many large social and medical questions, some of which are controversial, and others open up issues which are not perhaps as fully considered or presented as the reader would like. "The Case for Action" was widely criticized locally at the time because it seemed to be insufficiently realistic of the actual public services provided for the control and treatment of disease and for the promotion of public health in Peckham and elsewhere. The "Case" seemed to be more one for amendment of private practice and the existing medical services than the establishment of yet another form of clinic, and one not easily assimilable with existing institutions. Perhaps the conservative mind of the British public did not apprehend the purpose of a social club for families to have periodic medical examination, "without a bottle of medicine"; perhaps the purpose itself was presented in terms too technical and philosophical to be attractive to the lay mind. However this may be, the scheme has reached a stage when it is evident that it has confirmed some of the findings of Sir James Mackenzie's work in Burnley and at St. Andrews, and not a few of the findings of the institutions in America which advocate and practice the periodical medical examination of the 'normal' person. There is much to be said for this, as the Metropolitan Life Insurance Co. of New York long ago proved, as Mackenzie proved, the value of early subjective symptoms. Whether our urban populations are better satisfied when the medical man is 'biologist' and themselves are 'material' is another question. There is certainly no one more popular with them than the family doctor, and none more keen on health when they understand it. We must remember that Hippocrates himself said, "if you miss being understood by laymen, you will miss reality".

One thing is equally plain. The Peckham Health Centre has excellently demonstrated, beyond all doubt or question, the great principle, old and ever new, of the importance of seeing and knowing the *family*, both in diagnosing disease and in teaching the individual the way o' health, and still more in detecting disease which is minor or unsuspected. This was one of the advantages of the old-fashioned family physician. But this is not the only advantage revealed by the Centre. There is also the gain of a regular overhaul (so much advocated in America, and so little practised in England). It would also be well that such examinations of the 'normal' should have the purpose of health education rather than the objective of detecting unforeseen disease. One of the strong points, indeed the primary purpose, of the Centre, is the promotion of personal hygiene, its assessment and indications, and the increase in length of life, in capacity, and in well-being and happiness which may result from it.

We are glad that the promoters in this second statement are more positive and const uctive than in "The Case for Action"—and naturally so as the result of their labours—and are, consciously or unconsciously, wisely adjusting their case to the current advances in national health and the progress which has occurred in the locality since 1926. The sections dealing with the methods of examination and with nutrition are excellent, and full of suggestion to many other clinics. Indeed, their experience in regard to nutrition is timely and very instructive. The Centre families have no

shortage of food and are in contact with good and cheap markets and able to obtain sufficient and suitable food, *and yet there is malnutrition*, some of it severe. In short, the problem of nutrition cannot be solved by confining ourselves to food, quantity or quality. Apparently iron and calcium deficiency, the presence of worms, various febrile states, and ineffective assimilation of the food are responsible for much of the poor nutrition. Thus it seems there is no panacea for malnutrition, not even family allowances. Its cause, or one of its causes, is ineffective utilization by the body of the food consumed. This section of the report is very illuminating.

It seems that the Centre is not recruiting or keeping its membership quite as much as it had anticipated, and is not receiving all the support it had fairly hoped for, with the result that it is unduly restricted in the fulfilment of its purpose. This, we fear, is the usual disability of all pioneers. But the promoters of the scheme need not despair; their report contains positive elements of utility, and they have accomplished much in health education.

Hamilton and Geometrical Optics

(1) Geometrical Optics:
an Introduction to Hamilton's Method. By Prof. J. L. Synge. (Cambridge Tracts in Mathematics and Mathematical Physics, No. 37.) Pp. ix + 110. (Cambridge: At the University Press, 1937.) 6*s*. 6*d*. net.

(2) Geometrische Optik.
Von C. Carathéodory. (Ergebnisse der Mathematik und ihrer Grenzbegiete, Band 4, Heft 5.) Pp. iv + 104. (Berlin: Julius Springer, 1937.) 9.90 gold marks.

(1) FEW men were more versatile than Sir William Rowan Hamilton (1805-1865). In early youth he showed amazing linguistic ability, and attained a high standard in Latin, Greek, Hebrew, Italian, French, Persian, Arabic, Chaldee, Syriac, Sanskrit, Hindustani, Bengali, and other languages. He then turned to mathematics, astronomy and physics, and at the age of seventeen years he began to produce original work in geometrical optics. Hamilton's achievements were so great and so varied that it has taken the scientific world a long time to appreciate their full extent. Nineteenth century mathematicians esteemed him principally for his theory of quaternions. Since the rise of quantum mechanics, we now realize the fundamental importance of Hamiltonian dynamics. His optics, although his earliest work, has been the last to be appreciated.

The long neglect of Hamilton's methods in geometrical optics may be attributed to the fact that he attached primary importance to their theoretical aspect, and so he allowed his extensive work on the practical applications to the design of optical instruments to remain unpublished. These manuscripts were almost unknown until 1931, when they were printed in volume 1 of his "Collected Papers" (edited by A. W. Conway and J. L. Synge). Another reason why practical designers have neglected Hamilton's work is that, as published, it dealt throughout with the highly general and difficult case of anisotropic media, although it had been originally worked out for the much simpler isotropic case, which is all that is usually needed.

Hamilton's method is based on Fermat's principle, originally stated in the metaphysical form, "Nature always takes the shortest path." More accurately, the path by which light travels from one point A' to another A will be such that the time taken will be, in most cases, the least possible (and in general what is called 'stationary'). Hamilton's *characteristic function* V is proportional to this time, and theoretically all his results are obtainable from the mathematical conditions that V should be stationary. In practice, however, it is difficult to calculate V for an optical instrument. It is easier to deal with the *angle-characteristic* T, proportional to the time from N' to N, where N' is the foot of the perpendicular from a fixed point O' on to the initial ray, and N is similarly derived from the final ray and another fixed point O. We can also use the *mixed characteristic* W, proportional to the time from A' to N. H. Bruns (1848–1919), who, unacquainted with Hamilton's work, rediscovered part of it, though in a more complicated form, introduced the term *eikonal*. One of his eikonals was equivalent to Hamilton's T. Others were obtained by drawing planes through O' and O perpendicular to the axis of the instrument, cutting the initial and final rays in P' and P respectively, and then considering the time from N' to P, or from P' to N. These eikonals are functions of four variables, whereas V involved six, W five, and only T as few as four. Prof. Carathéodory considers that Bruns made an important advance on Hamilton's work in this respect, but Prof. Synge strongly dissents from this opinion, and declares that the use of the word eikonal is neither necessary nor desirable. His tract is a simple and straightforward account of

V, W, T, with their applications to the leading properties of optical instruments. He deals with the relation between object and image, the foci, focal lines and planes, nodal points, principal points, magnification, the defects (spherical aberration, astigmatism, coma, curvature of image, and distortion), Abbe's sine condition, and some cases of dispersion (chromatic aberrations). For the system treated as a whole, Hamilton's methods (or their modifications) seem the most powerful yet devised, though for isolated problems shorter solutions can be found.

(2) Instead of starting from Fermat's principle, geometrical optics may be based on Huygens's principle, that the wave front is the envelope of secondary waves the centres of which are on a previous wave front. The rays (in an isotropic medium) are the normals to these wave fronts. Prof. Carathéodory, reversing Hamilton's procedure, starts with Huygens's principle, which he develops by the aid of Cauchy's theory of characteristics of differential equations. This leads to Poincaré's and Cartan's theorems on integral invariants, which are generalizations of Malus's theorem that rays, initially normal to some surface, finally emerge, after any number of reflexions and refractions, as normals to another surface. Much stress is laid upon *canonical direction co-ordinates*, which are analogous to the momentum co-ordinates used in Hamilton's dynamics. The usual equations of the calculus of variations, expressing the conditions for a stationary path, are replaced by the canonical equations of the Hamiltonian function, again as in dynamics. In the subsequent work, a great part is played by Lagrange's brackets and canonical transformations. Rather unexpectedly these lead to the eikonals, and we suddenly realize that the formidable pure mathematics has, after all, a physical application. However, Prof. Carathéodory's emphasis is certainly on the mathematics while Prof. Synge's is on the physics. Both books may be warmly commended, and the fact that Hamilton's work can be developed in two such different ways is evidence of the versatility of his genius.

H. T. H. PIAGGIO.

Presentation of Physical Chemistry

(1) An Introduction to Physical Chemistry
By F. A. Philbrick. Pp. ix + 368. (London: J. M. Dent and Sons, Ltd., 1937.) 5*s*.

(2) Elementary Physical Chemistry
By Prof. Hugh S. Taylor and Prof. H. Austin Taylor. Second edition. Pp. xiv + 664. (London: Macmillan and Co., Ltd., 1937.) 16*s*. net.

(3) Lehrbuch der physikalischen Chemie in elementarer Darstellung
Von Prof. Dr. John Eggert. Vierte, verbesserte Auflage. Pp. xii + 681. (Leipzig: S. Hirzel, 1937.) 25.50 gold marks.

(4) Praktische Einführung in die physikalische Chemie
Von Karl Lothar Wolf und Hans-Georg Trieschmann. Erster Teil: Moleküle und Kräfte. Pp. viii + 114. (Braunschweig: Friedr. Vieweg und Sohn, 1937.) 4.80 gold marks.

(1) IN recent years, physical chemistry has been specifically included in the syllabuses for the various higher school certificate examinations, and this book is intended for students who are working for these and similar examinations. All the topics generally included in elementary physical chemistry are discussed, and in addition there is a useful chapter on the theory of analysis. The treatment is simple and clear, and essentially descriptive rather than mathematical. The point of view is commendably modern: the student whose knowledge of physical chemistry is based on this book will find that he has little to 'unlearn' during the course of his more advanced studies at the university. Subjects such as radioactivity, isotopes, atomic structure and electronic theory of valency are not included, and the author has wisely avoided a number of other matters which are much better left to a later stage.

The reviewer's chief criticism of the book as a whole is that the historical background has been almost entirely ignored: Traube and Pfeffer are not mentioned in connexion with osmotic pressure, where the only names recorded are those of Morse and Frazer, and Graham finds no place in the chapter on colloids, where due credit is given to von Weimarn and to Bredig. There are, however, many good points about this book; it would be impossible to refer to them all, but special mention must be made of the neat deduction from the kinetic theory of the pressure of an ideal gas.

When another edition is in preparation, the author would perhaps consider making some small changes: for example, it is doubtful whether sulphuric is weaker than hydrochloric acid (p. 103), and whether simultaneous adsorption of both reactants is generally involved in heterogeneous catalysis (p. 120). The molecular conductivity has fallen into disuse, for good reasons, and should be replaced by equivalent conductivity. A phase diagram for phosphorus would help considerably

in connexion with the description on p. 302, and mention of the terms enantiotropy and monotropy would not be out of place there. These matters are, however, relatively unimportant, for the book is one which can be recommended for its intended purpose; both pupils and teachers should benefit from its use.

(2) The first edition of Taylor's well-known "Elementary Physical Chemistry" suffered to some extent from the fact that it had been adapted from the two-volume treatise compiled by a number of different authors: there were certain gaps and some inequalities of treatment. The appearance of a new edition, revised by Profs. H. S. and H. A. Taylor, is to be welcomed, because there has now been an opportunity for the material to be welded into a more coherent whole.

In addition to a general revision, two new chapters have been introduced; one deals with the development of the quantum concept and its application to atomic and molecular systems, whereas the other considers these applications in more detail with reference to gases, and includes such subjects as rotational and vibrational heat capacities, ortho- and para-hydrogen, and zero-point energies. Elementary quantum concepts have also been introduced into the chapter on the velocity and mechanism of chemical reactions, and this portion of the book, as is to be expected from its authors, is of exceptionally high standard.

The section on the atomic concept of matter has been brought up to date, but it is unfortunate that the impression is given (p. 36) that the nucleus is still considered to consist of protons and electrons. In accordance with modern ideas the treatment of solutions is based on Raoult's law; the authors should, however, have given greater emphasis to this point in the discussion of ideal solutions (p. 327). Although the chapters on electrochemistry are quite good, the treatment of salt hydrolysis is open to criticism, and it is hoped that an early opportunity will present itself for this section to be amended.

The book concludes with three appendixes, dealing respectively with the deduction of Maxwell's distribution law, of Planck's expression for the mean energy of a linear oscillator, and of the limiting law of Debye and Hückel. The first and last of these involve fair mathematical skill, and it has evidently been considered advisable to keep them out of the main body of the text: this procedure will meet with the approval of many students who are still finding their way among the foothills of that imposing mountain range which is physical chemistry.

Since the first edition of this book was published in 1927 it has been reprinted four times, and there is every reason to expect, from its content and style, that the demand for the new edition will be even greater.

(3) Although the third book on the list is described as an "elementary presentation", it is doubtful whether it could be appreciated by a reader who has not already some knowledge of the fundamentals of physical chemistry, and this point should be borne in mind. The treatment of atomic structure, and of related topics, is particularly good, but a severe critic might question the wisdom of devoting more than a quarter of the book to the consideration of atomic and molecular structure, although less than four pages are accorded to the modern theory of valency. There is always a danger, when writing a relatively advanced text-book, of occupying too much space with matters in which the writers are specially interested or which happen to be topical, with the result that others of fundamental importance are treated too briefly. This may be illustrated by the fact that in this book only 16 pages are given to the osmotic properties of dilute solutions, including experimental methods and diffusion: in the opinion of the reviewer, this is too small a proportion of a book with 640 pages of text.

The arrangement of the material is unusual in some respects, although it could probably be readily justified. It is surprising, however, to find that the phase rule is not mentioned until after the treatment of one- and two-component systems. Nevertheless, this is one of the most interesting of modern text-books of physical chemistry. Its wide appeal is shown by the translation of earlier editions into English, Italian, Russian and Spanish, and four German editions have been published in eleven years.

The present issue, like its immediate predecessor, has been revised by the author in conjunction with Dr. Lothar Hock, and it is quite evident that the work has been well done: not only have many portions been rewritten or rearranged, but also the material added has necessitated an increase of nearly 80 pages. The book has one disadvantage from the point of view of readers in Great Britain and in the United States: the thermodynamic symbols are not those generally employed in these countries.

(4) The book by Wolf and Trieschmann is of an unusual type: it is not so much a text-book of practical physical chemistry as an account of the principles of the subject. A number of exercises are suggested and their theoretical basis explained, but for experimental details the reader is referred to standard German texts of theoretical and practical physical chemistry and physics. Where these are available this small book, which covers the field of ions, atoms and molecules, and gases and liquids, should be very useful, but otherwise its value is restricted. S. G.

Physiological Chemistry of the Bile

By Harry Sobotka. Pp. xii+202. (London: Baillière, Tindall and Cox, 1937.) 13*s.* 6*d.*

THIS volume aims at providing the experimental worker in physiology, pharmacology and experimental medicine with a survey of our present knowledge of the biliary secretion. It is intended to be read, however, in conjunction with a companion volume by the author called "Chemistry of the Sterids". Without reference to the latter, certain sections on the bile acids in the present book are not clear, since the author refers to the rings and carbon atoms of the bile acid structure by numbers; for example, "ring III", "$C_{11} = C_{13}$"; these sections would be much easier to read if a skeleton structural formula of the bile acids with the rings and C atoms appropriately numbered were included, thus avoiding unnecessary references to the companion volume.

The first half of the book deals mainly and thoroughly with the composition of normal bile, and there is an introductory chapter on the general physiology and structural relations of the tissues involved in bile formation. One feels that a book on the physiological chemistry of the bile is incomplete without at least a brief account of the bile pigments, a discussion of which has been excluded from the present volume. The author, however, disarms criticism by stating that they could not be treated adequately without an extensive exposition of the physiology of the blood pigments and the chemistry of pyrrole derivatives.

The last half of the book deals mainly with the pharmacological aspect, especially with choleretics and cholagogues. A brief account is also given of bile and bile acids in pathological conditions.

The book should be stimulating to research workers, since gaps and uncertainties in our knowledge of the bile, together with suggested lines of investigation, are clearly indicated and constantly referred to by the author. Many of the earlier results in this field require re-investigation. There is an extensive bibliography, which occupies one quarter of the book. The latter has the merit of satisfying a need and of collecting together in an orderly fashion a large number of scattered data concerning the biliary secretion. R. T. W.

On Guard against Gas:

an Account of the Principles of Gas Warfare and of the Steps to be taken by the ordinary Citizen to defend his Family. By H. A. Sisson. Pp. 91. (London: Hutchinson and Co. (Publishers), Ltd., n.d.) 2*s.* net.

IT is a pleasure to turn to a book dealing with poison gas which has been written by an expert who has had personal experience of it not only in the laboratory and experimental ground, but also on the battlefield itself. Major Sisson held an important appointment in the Gas Directorate of the British Expeditionary Force during the Great War, and he has first-hand knowledge of the practical use of gas and can estimate its probable effects if it is employed against a civil population. His opinions, therefore, should carry weight with the majority of people, who are naturally ill-informed in a matter remote from their ordinary experience and have been grossly misled in the past by sensational writers.

The author considers that gas would be a minor danger in an air raid if people can be made to understand it. Besides being told what precautions to take against it, they ought to learn the reasons for the recommendations made. It may not be possible to make one's home safe against fire and explosives, but it can certainly be made reasonably proof against gas, and scarcely any serious casualties need be expected from it among a fully instructed community.

The book is not intended to be a substitute for the official A.R.P. Handbooks, which the author considers excellent, but to supplement them by giving a more general view of the subject in the form of a connected story. It describes in non-technical language the different kinds of gas that are most likely to be used in air raids and explains their action and the method of 'catching' them in modern respirators. There are also chapters on the experience gained from the Great War in regard to the employment and effects of gas, and on the preparation of gas shelters in the home.

This excellent little book is within the reach of every pocket and it should be widely read, especially by nervous householders. C. H. FOULKES.

Bio-Politics

an Essay in the Physiology, Pathology and Politics of the Social and Somatic Organism. By Morley Roberts. Pp. xv+240. (London: J. M. Dent and Sons, Ltd., 1938.) 15*s.* net.

MR. MORLEY ROBERTS'S study of the social organism, as he admits and indeed proclaims, is based on analogy, specifically on the thesis that the communities of bees, ants and termites, and therefore also human societies, resemble organisms. "Whatever the groups, the laws of organic development which produce order, form, interdependence, and differentiation are everywhere the same." Hence, studies in the pathology of single animals can be applied to the functions of social and national groups. "Where protoplasmic units, however simple or complex, work together in symbiosis or communal life, they can best be considered as organisms, and as such liable to the diseases and disorders which change or destroy them." He is not afraid of carrying his analogies to an extreme. For example: "After what was said earlier on immunity, students of medicine will have no difficulty in thinking that sarcoma, or malignant revolt of various connective tissue elements, may be nearly matched by a revolt of the police."

It would take many pages to explain that Mr. Roberts's assumption of the existence of biological laws of any kind is rash, as the "laws" are no more than abstractions from observations limited strictly to the precise conditions in which they were made, and without wider validity. But he is a writer of great ability, and has collected a large number of interesting facts, so that his book is stimulating and useful.

Geology and Archæology of the Hadhramaut, South-west Arabia

Preliminary Notes on the Lord Wakefield Expedition

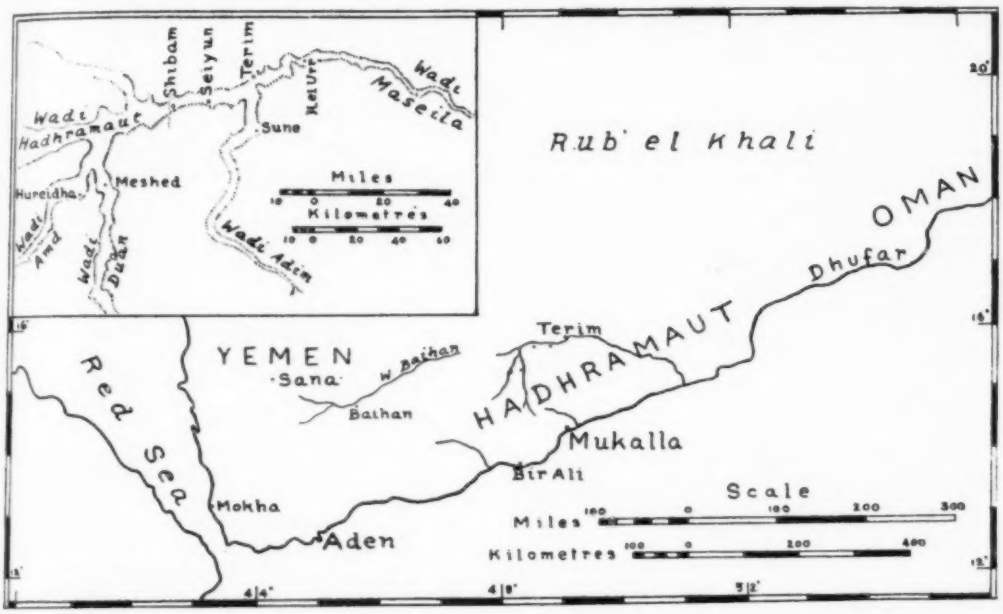
By Miss G. Caton-Thompson

ON September 18, 1937, Dr. S. A. Huzayyin gave a preliminary account in NATURE of the results of the Egyptian University Scientific Expedition to the Yemen and Hadhramaut. It may be advantageous, therefore, also to record in brief the geological and archæological results of the Lord Wakefield expedition, which worked in the western part of the Hadhramaut last winter. The party consisted of Miss Freya Stark, whose knowledge of the country and language made scientific work by her two companions possible in a land still unaccustomed to, and suspicious of, Europeans; Miss E. W. Gardner; and myself.

The geological work was limited to the Pleistocene, and was concerned mainly with the physiography of the mighty wadi system, with special reference to dating and past climates.

Archæologically, we were confronted by a land of romantic traditions centring round the incense trade, of which the early material culture was virtually unknown, and which consequently had tended to become a dump of untested theory not unusual in regions where literary and epigraphical records have been unpartnered by archæological facts. Consequently all relics of pre-Islamic habitation, irrespective of date, were welcomed, provided only these were found in association and *in situ*.

The Wadi Hadhramaut from Terim westwards for more than forty miles seemed at the points



examined to be of slight importance for any but early Islamic sites, though rock-engravings and accompanying rude scrawls in the South Arabian characters* were found, rather scantily, at certain points. An unrecorded pre-Islamic site near Shibām, probably of little value, was noted but not dug.

Geologically also, the main wadi proved unprofitable in this stretch, for though its scree-slopes yielded numbers of palæoliths, no deposits harbouring them *in situ* were found. If gravel terraces exist, they are deeply blanketed by great deposits of æolian silt which floor the valley, and drown the lower talus slopes.

In the Wadi Amd, a northward-draining major tributary of the Wadi Hadhramaut, where shortly

* It seems better to avoid the terms 'Himyaritic' and 'Sabæan' or their compound, until they are chronologically and geographically defined by archæological method.

before Christmas we settled in the little town of Hureidha, luck changed, and we were kept busy with a superabundance of material and its systematic excavation.

GEOLOGY*

The Wadi Amd is two to three kilometres broad, and is floored, like the main valley, with a gently sloping fine æolian silt, a deposit partly wind-, partly water-laid. Bordering the main flood channel, gravel is exposed, both in terraces and interbedded with the silt. These we were anxious to date, for after the original cutting of the valley to some unknown depth the deposition of gravel and silt were the most important events in its history. There are three terraces. The highest and best developed lies at ten metres above the wadi floor; the lower ones are laid against it at five and three metres.

The ten metre terrace is distinguished from the others by the æolian silt interbedded in it, and in places overlying it. This is identical with the silt of the valley floor; and the finding of tools, both in it, and more abundantly in the gravels, dates the infilling, or at least the upper part of it, to palæolithic times. The implements, specially numerous in the ten metre terrace, belong to the Levalloisian culture, but unlike many of their relatives in Egypt, in Palestine, or others as geographically near as Somaliland, these Hadhramaut tools are crude in workmanship, and undifferentiated in type. Here no succession of stone-age cultures breaks the monotonous continuity of the Levalloisian tool-making. Hand-axe cultures seem to be absent (the Egyptian expedition found one specimen in the Yemen); likewise the blade and burin industries, of which the route into Africa may therefore not be sought via Southern Arabia as many, including myself, had believed. Wherever we searched, on the high plateau or jōl, on the spurs and screes of the Wadi Hadhramaut, in the lateral valleys, the Levalloisian type of tool alone was found, and in great numbers. It seems as though its manufacture must have persisted in these parts long after Africa and the Near East had progressed to more advanced stages of stone-age development. An obsidian industry of small blade cores and geometric forms was indeed found; but this was proved conclusively to be historic, and at most not older than a few centuries before the Christian era—a conclusion already reached by Dr. Huzayyin.

The Egyptian expedition had traced in the Yemen a series of pluvials in prehistoric times, and a minor oscillation in the historic period, the latter based on archæological evidence such as dry wells and empty tanks. We cannot say we found indications of greater rainfall in the Hadhramaut in historic times; but on the evidence of the palæolithic gravels, it seems indisputable for part of the Pleistocene.

That the æolian silt deposition in the valleys is due to climatic rather than to local physiographic causes, such as ponding by lava flows in the lower reaches of the main wadi, seems assured also by our observation of similar deposits choking the shallow valleys on the high plateau, far removed from the influence of Wadi Hadhramaut, and lying between it and the sea. Climatic implications were extended further by the discovery of Pleistocene travertines crowded with vegetation; these, which were dated by derived pebbles in the ten-metre gravels, may throw interesting light on the past flora of the country.

If the upper part of the filling of these great wadis trenched 300 metres in the limestone plateau, is Middle to Late Pleistocene, it is evident that the original cutting is pre-Quaternary. The climatic changes of the European Ice Age with which the cutting of the Hadhramaut valleys had formerly been correlated, affected only the nature and amount of their subsequent infilling and recutting.

ARCHÆOLOGY

The work, which was necessarily of an exploratory nature, was centred on Hureidha. It covered the chief aspects of pre-Islamic activities in the region, and yielded information concerning domestic dwellings, irrigation works, and places of worship and burial.

No reliable information could be had beforehand as to prospects of getting labour for digging, and difficulties had been prophesied. It was a surprise, therefore, to find a sufficiency of recruits for the unfamiliar work. They were, on the whole, intelligent and agreeable to direct, and compared well with similar untrained labourers in the Near East.

Irrigation and Houses. At first glance the ruin-field, intermittently scattered over about ten square kilometres of the loess-like plain, looked uninviting. Its noticeable feature was a large number of fairly evenly spaced stone-rubble heaps, which sprang from bare wind-swept ground. Detailed mapping proved them to be relics of a big irrigation system. In this respect, fortune had economized her resources, for it so happened that Miss Gardner, some years ago, had mapped a Ptolemaic irrigation system discovered in the desert Faiyum. Comparison of the two systems will be an interesting study in ancient man's ingenious inventions in both regions to turn a desert into a fertile plain on a scale seldom initiated to-day.

* I am indebted to Miss Gardner for the geological notes.

The source of the water was the monsoon summer rain; the flood was led off the main channel far above the irrigated area, and carried to it by a canal 16–20 metres broad, still discernible in the sandy waste. From this, numerous smaller channels distributed the water in a network of runnels.

There was no evidence that a town or even a village had existed amongst these fields now desert. But some knolls smothered in sand showed, by a scatter of sherds, that house foundations, singly or in clusters, lay beneath. One such homestead was excavated, and disclosed a five-to-six roomed mud-brick building, formerly limewashed, fitted with mud-brick benches. Logs of wood reinforced the door-treads, and the ceiling had been constructed in the fashion still practised in the region, of twigs laid in parallel bundles across rafters and over-daubed with mud. Few objects except broken pots were found here, but the form of these, supported by inscribed fragments, served to equate the dwelling with the temple and tombs we excavated near by.

The Temple. The temple, the first of its kind to be excavated in South Arabia, which was completely buried in drift, stands in the formerly cultivated plain. It is an oblong structure 17 metres × 20 metres in size, set on a raised platform capping a natural eminence, with its main façade on the south-west. From here the ground falls sharply to a depression or basin, the artificial origin of which is attested by a bordering throw-up of clayey silt, now greatly weathered, but still impressive in extent. We noted a similar depression at the foot of the unexcavated temple-mounds at Meshed, and surmise that these basins may form an integral part of temple plans in South Arabia.

The podium is faced by massive stone-rubble walls, four to five metres high, and half a metre thick, set on a batter of 7°. Twenty-one courses of roughly shaped sandstone blocks, bonded and mortar-bedded, still stand, topped by a coping of huge ashlar blocks of rusticated work with drafted borders. The interior was levelled up by a dry filling of great boulders. A top dressing of small mortar-laid pebbles formed the bed of a flagged pavement, which still lay intact over a considerable area.

Little remained of the superstructure except the stumps of five tapering blocks with square bases set in parallel alignment which may be the remains of thin columns*, or aniconic objects; and vestigial partition walls of polished lime-plaster of finest quality, in part recessed. These define a forecourt giving access to the main 'pillar' area through a narrow flagged passage and entrance.

* Columns are an important feature in pre-Islamic temples in Yemen (*cf.* Rathjens and Wissmann, "Südarabien Reisen". Band 2. Hamburg, 1932.)

Structural evidence was obtained for at least three phases of building, rebuilding or readaptation, which finally raised the platform floor above that of the podium coping, and extended the original building by important additions to the south-west front. These are referred to in one of more than fifty inscriptions found; and interesting light may be thrown on rebuilding activities and their authors' names, when all have been studied by Prof. Ryckmans of Louvain, who has most kindly undertaken the task.

The temple platform was reached by two stone stairways. One, the older and more important, though even so not part of the original structure, gave access from the south-east; its base widened out to nearly three metres, and an inscribed slab had been carelessly reutilized in a tread. The other, later, stairway, only a metre wide, approached via the south-west angle. Built into it also were several discarded inscriptions. Both these flights took off from a circumambulatory pavement considerably above the surrounding level of the original building. Sherds were collected in test pits down to 2·80 metres below this pavement.

There is reason to suppose that the building was originally wholly plastered; pavings, stairways and partition walls were certainly thus faced. Whether the rubble retaining walls were treated in the same way is uncertain but not improbable.

Clearance of the very interesting peripheral buildings crowded round the temple base had, of necessity imposed by time, to be confined to those lying at the foot of the south-west façade, itself added in the latest period. A 'temenos' area was therefore not delimited. The cluster of outlying buildings was, however, of outstanding interest, for it included a pair of perfect, and remains of other imperfect, apsidal structures of small size, characterized by a central free-standing, altar-like stone, surrounded by a low kerb or by a bench of flat slabs, rectangular on three sides, convex on the front.

That these places, though amongst the latest additions, were shrines of aniconic religion seemed proved; for standing erect against the base of one such 'altar' were two baetyllic stones, one rudely fashioned from a stone-brick into human form, the other a symmetrically tapered, rough-dressed, stone. Both were carefully embedded upright in plaster, and before both were placed stone incense-burners of rectangular form, stained red and patterned, as well as earthenware saucers and a stone offering-tray.

The temple, referred to in one of the dedicatory inscriptions by the name of Madabûm, was devoted to the worship of the Moon God, whose name occurs on all the inscriptions so far examined

by Prof. Ryckmans, and whose symbols appear also on funerary pottery and stone. To that deity burnt offerings were made in fire-altars.

The inscriptions must belong to the earlier periods of the building's existence, for the large number actually *in situ* were obviously in secondary, and not original, positions. Some indeed had been built-in upside down or sideways to the lettering; others were exposed only on removal of a plaster-coated floor or step; yet others lay beneath the circumambulatory pavement, or had been ruthlessly cut down to fit their new position. Traces of a red staining like that on the incense-burners were repeatedly observed upon them.

Of considerable interest in this context is a graffito of a running camel with outstretched neck, resembling in style many of the naturalistic rock-drawings sometimes rashly assumed to be of prehistoric age.

The Tombs. Those examined lay in the lower slopes of the cliffs some half-mile from the temple and dwellings, the general contemporaneity of which was proclaimed by the pottery common to all. They consisted of artificial caves quarried back into the sloping talus, and were roughly circular cavities of varied size; the couple excavated measured 8 metres in diameter by 2·40 metres in height. Drift and cave-rubble filled them almost to their ceilings. One example had low benches cut in the walls to receive the corpses singly, or in double-decked loculi. This tomb was entered by a narrow down-sloping dromos 5 metres long, cut into the cliff side; passage and entrance had been skilfully repacked with scree, difficult to distinguish from the natural undisturbed article. The cliffs here seem to be riddled with cave tombs, a few of which have been cleared by bedouin and reused as dwellings or goat pens. Others have been partially plundered and abandoned.

The second cave-sepulchre examined amplified and corrected the deductions drawn from the first. It contained one bench only, upon which a skull and single bone rested amongst a group of ten pots, shells and miscellanea. But here, unlike the other tomb, the floor itself presented an astonishing mass of sherds and pottery vessels—sixty more or less complete ones were recovered, some inscribed—mixed up with forty-two skulls, disarticulated and fragmentary bones, and simple grave goods. It seemed at first legitimate to infer very complete plunder of a communal tomb by contemporary robbers. But this in no way explained the singular disproportion gradually observed in the parts of the skeletons present. For example, whereas this chamber contained forty-two skulls, it yielded only seven lower jaws, and these mostly in fragments. A theory of fractional burial seemed beside the mark, for the confusion exceeded the bounds probable in any pious practice. It seems preferable to invoke the explanation of an ossuary. In the first place the population, as evidenced by the loculi caves visited, buried their dead in family sepulchres. Over a fairly prolonged period (during which the temple was twice altered) an insufficiency of suitable tomb-sites within reasonable distance or permitted limits developed. The older tombs were cleared of their mouldering bones and grave goods, and these were unceremoniously redeposited *en masse* in an ossuary. Future work will test the validity of this interpretation, which on present data seems best to fit the facts.

Twelve skulls alone were complete enough for preservation. They are markedly long-headed, and uniform in type, but along with the other finds await detailed study.

Viewed as a whole, the semi-civilized culture thus brought to light near Hureidha can lay no claim to be in the vanguard of progress of its period. Pronouncement on the date must be reserved; it probably lies within the last few centuries before the Christian era. Apart from the irrigation system, imitation is more apparent than initiative. The pottery is monochrome, hand-made and clumsy, though fairly ambitious in form. Debased amulets of Egyptian derivation were cherished, and seals denote intercourse with Syrian or Babylonian regions. The beads, on the other hand, contain Eastern as well as East Mediterranean elements, and should, when expertly examined, yield their quota of evidence to an interesting story.

An exhibition of the finds will be held at the Fitzwilliam Museum, Cambridge, by the courtesy of the director, Mr. Louis Clarke, during the meeting of the British Association in August, and will form the first authenticated group of archæological material from the Hadhramaut obtained in excavation.

The expedition was primarily made possible by the generosity of Lord Wakefield, to whom archæologists must be under a debt of gratitude for the acquisition of entirely new data; and it received also invaluable support from the Royal Geographical Society, from Mr. Louis Clarke on behalf of his Museum, and from the Ashmolean Museum, Oxford. Our thanks, moreover, would be incomplete without acknowledgments to the International Federation of University Women, from which Miss Gardner holds a senior science fellowship enabling her to join the expedition; and finally to Mr. Ingrams, First Political Officer to the Hadhramaut, and to Mrs. Ingrams for their cordiality and kindness.

Modern Views in Physics

International Conference

THE International Institute of Intellectual Co-operation is an organ of the League of Nations which at intervals arranges small conferences of experts in various subjects. In the past it has given its main attention to educational, historical and archæological subjects, but recently it has extended into science; for example, not long ago it organized a small conference in Paris on phytohormones; another at Neuchâtel, on the molecular and atomic weights of gases, a third one in Prague, dealing with the publication of ancient scientific manuscripts. It recently embarked on a larger scheme by inviting about thirty physicists to meet in Warsaw for the purpose of discussing the philosophy of physics. The meeting took place on May 29–June 2 under the presidency of Prof. Białobrzeski; as hosts there were Profs. Rubinowicz, Szczeniowski, Weissenhof, Wertenstein and Wiśniewski, and the following guests accepted invitations: Profs. E. Bauer, Niels Bohr, L. Brillouin, L. de Broglie, C. G. Darwin, Sir Arthur Eddington, R. H. Fowler, G. Gamow, S. Goudsmit, E. Hylleraas, O. Klein, H. A. Kramers, L. de Kronig, P. Langevin, C. Moeller, J. von Neumann, F. Perrin, L. Rosenfeld, E. P. Wigner.

Reports had been prepared in advance by a number of the members to serve as bases for the discussions, and a great deal of profitable argument ensued. The detailed discussions will be printed later by the Institute, and until they appear it is not possible to give more than a very rough impression of the proceedings. The reports were furnished by Bohr on the indeterminacy of quantum mechanics, by L. de Broglie on the relations of quanta and relativity, by Brillouin on the individuality of the elementary particles, by Eddington on the relations of quanta to cosmology, by Milne on his cosmology, by Klein on field theory and by Langevin on the relation of positivism to physics. Heisenberg was also to have made a report on the limits of applicability of our present mechanics in connexion with particles of great energy, but he was unable to attend and his place was taken by Kramers, who has been in close touch with his ideas and, among other interesting things, told us what Heisenberg would have said if he had been there.

It will be seen that the subjects divide roughly into two parts, connected respectively with the foundations of physics and with the recent work on the various kinds of elementary particles. With regard to the foundations, such discussions are of great value in helping to summarize present opinion, but when we consider what that opinion is, it is difficult not to feel rather pessimistic. The enormous triumphs of the quantum theory have all been in the branches and scarcely any in the roots. Difficulties connected with such things as radiation theory and the self-energy of the electron remain much what they have long been, and it is scarcely too much to say that if this conference had been held in 1930 the chief difference would have been that the catalogue of abortive attempts would have been shorter. Indeed the situation was summarized by Kramers in the words: The quantum theory has been very like other victories; you smile for months and then weep for years. The inexpert listener would have concluded from the discussions that the quantum theory is a poor thing and would have wondered why anyone believed in it, forgetting that on such occasions it is the points of difficulty that are considered and that no time is wasted over the very much larger field where there is a consensus of agreement.

It would not be easy to describe what was said about the fundamental difficulties, because from the nature of things the ideas of the speakers are not in clear shape, but there did seem to emerge one real divergence of opinion between what may be roughly called the mathematical minds and the physical. The mathematician tends to attack the problem of foundations by setting down a scheme for the whole universe; it has to accommodate all the necessary characters, relativity, exclusion principle and so on—making use of any technical methods, matrices, wave-functions or double quantization, that suit the author's taste—and he then tries to specialize his scheme so as to deal with the limited problems that the experimenter studies. The opposite view is taken by others, led by Bohr, who insist that nothing can be grasped by the human mind except in classical terms, so that there is always a classical basis—of fields of force, barriers, slits, etc.—underlying every problem of quantum mechanics; the quantal system moves under these controls, and though it may be possible to enlarge the system so as to include more and more particles quantally, it is never possible to go to the limit and include the whole universe. This does seem a real divergence of opinion, and, if the second view is right, the various attempts at world structure of the first type are necessarily doomed to failure.

Some of the most interesting discussions were connected with more technical matters, on which positive results may be attained. Thus Brillouin reviewed the present state of our knowledge of the elementary particles; this is nowadays quite a long list as it includes along with the older ones the photon, the neutrino and the heavy electron or 'yukon', as it has been called after Yukawa who first, and before the experimental discovery, studied some of its possibilities. The discussion was largely concerned with the relation of spin to the statistics which each particle should obey. It appeared that though this is governed by certain rules, so that half spins go with Fermi statistics and whole with Einstein, yet there is a complete lack of proof for the necessity of this connexion. Then Eddington gave an account of his theory of electrons and protons, and had to defend his position against criticism from many sides. Milne was not there, and his report was read but not discussed.

The work of the conference was not so heavy but that we had opportunities for seeing the sights of Warsaw, and several brilliant entertainments were given by our Polish hosts, including a luncheon party, where we were entertained by the President of the Republic in the Castle of Warsaw. It is noteworthy that in Poland, more than in most countries, a scientific career may lead to high political office, for until the cares of State engrossed his whole attention, the President was himself a physicist, and the Minister of Education, who entertained us at dinner, was, and in his spare time still is, a physical chemist. At the end of the conference many of the visitors paid a visit to the beautiful city of Cracow with its historic university. Altogether, from both the social and the intellectual side, the meeting was agreed by everyone to have been a great success, and the guests carried away most pleasant recollections of their visit.

C. G. DARWIN.

Obituary Notices

Mr. W. M. Mordey

MR. W. M. MORDEY, the eminent consulting engineer, died suddenly at his home in Warlingham, Surrey, on July 1, at the age of eighty-two years. He was one of the best known electricians, and besides his professional work did valuable research work. He was president of the Institution of Electrical Engineers in 1908 and was made an honorary M.I.E.E. in 1932.

Mordey was born at Donnywell, in the County of Durham, in March 1856 and was the second son of J. G. Mordey, whose father was an eminent surgeon and had been several times Mayor of Sunderland. At the early age of fourteen years he entered the P.O. Telegraph Service when it had just taken over the telegraphs from the companies. A few years later when stationed at Bradford he held classes under the South Kensington regime. In 1881 he left the P.O. service and went to the Brush Company's works at Lambeth. He was soon advanced to the responsible position of chief of the test room and became electrical designer in general. He did valuable work in developing compound winding for dynamos. He gave convincing proofs of the practicability of running alternators in parallel which then became a practical instead of merely a theoretical operation. At that time the Mordey alternator was the best parallel running alternator on the market. The 'Victoria brush' dynamo designed by Mordey was almost in general use for many years especially for ship lighting. He established against high authority that a good dynamo is also a good motor. When working on transformers he studied the magnetic ageing of the iron, and with the assistance of Messrs. Sankey succeeded in getting made the material 'stalloy' which was relatively free from many of the ordinary defects. Mordey accepted no theory until it had been practically tested and testing meant to him measuring.

One of his inventions when he was with the Brush Company was the invention of a dust-filled fuse which 'blew' safely on 2,000 volts, alternating current, and was one of the earliest of arc-extinguishing fuses.

Mordey left the Brush Company in 1895 and set up as a consulting engineer. When R. A. Dawbarn joined him the firm was called Mordey and Dawbarn. They carried out some important works in South Africa and South America. In his presidential address in 1908 he vindicated the English electrical engineering industry from the criticism that it lagged behind some other countries.

Mordey took a leading part in the committee which the Council of the Institution of Electrical Engineers appointed in 1908 to find a suitable building in which to hold its meetings. At that time the meetings were held in the lecture hall of the Institution of Civil Engineers which was kindly lent to them. The committee decided almost at once to purchase the Medical Examination Hall of the Royal Colleges of Physicians and Surgeons which was then on the market. The purchase was effected for £50,000 on a seventy-six years lease. Since then the membership of the Institution has increased nearly three times, a fact to which Mordey referred with pride a few years ago.

Mordey discovered a curious effect produced when certain finely divided minerals were placed in an alternating magnetic field. The particles repelled one another and by suitable apparatus he was able to apply the phenomenon to the separation of ores.

His earliest published account of these experiments was read at a meeting of the South African Institute of Electrical Engineers at Johannesburg on December 16, 1921. His full statement and his explanation of the effects were given in his Friday evening discourse at the Royal Institution on May 18, 1923.

For many years, Mordey was a member of the Council of the Institution of Electrical Engineers and being very sociable he used to stay to many of the Council dinners. His criticisms of the papers read were frank, but his remarks were often very helpful. He was a member of the Athenæum and of the Alpine Club. He loved to talk about mountaineering in Switzerland and climbing the snow-clad hills of Scotland in winter time to the astonishment of resident farmers. The profession and the industry have greatly benefited by his work.

Mordey was fond of good music and was a member of the Bach choir for many years. The early death of his first wife leaving him an only daughter was a great blow. His daughter married Major E. O. Henrici, but after having a family she died comparatively young. Another blow to him was the death of his partner Dawbarn. He has left many friends who will sadly miss him. A. R.

THE death has recently occurred of Dr. Ragnar Rydberg, lecturer in physics in the University of Stockholm, at the early age of thirty-six years. Dr. Rydberg's scientific career was mainly devoted to the field of band spectroscopy, from which his beautiful methods of graphical constructions based on extensive spectroscopic data were developed. His dissertation: "Über Neubildung und Zerfall zweiatomiger Moleküle" (Stockholm, 1934), also included valuable discussions on problems regarding predissociation phenomena in discharges under different conditions.

WE regret to announce the following deaths:

Dr. B. T. Galloway, pathologist in the Bureau of Plant Industry of the U.S. Department of Agriculture, on June 13, aged seventy-four years.

Dr. A. E. H. Tutton, F.R.S., formerly H.M. Inspector of Schools (Technological Branch), Board of Education, and a leading authority on chemical and physical crystallography, on July 14, aged seventy-three years.

News and Views

Prof. M. N. Saha, F.R.S.

AFTER nearly fifteen years of service in the University of Allahabad, Prof. M. N. Saha is returning to his Alma Mater, the University of Calcutta, as Palit professor of physics. The first occupant of this chair, the gift of a rich Calcutta lawyer to the University, was Sir C. V. Raman (1918–32), and he was succeeded in 1932 by Prof. D. M. Bose (1932–37), who is now director of the Bose Research Institute founded by his uncle, the late Sir J. C. Bose. Prof. Saha graduated from the University of Calcutta in 1915 in applied mathematics, and in 1917 became lecturer in physics in the newly founded University College of Science. Between 1917 and 1921, he published a number of papers in the *Philosophical Magazine* and other journals on the application of the special theory of relativity to electrodynamics, on selective radiation pressure and its application to astrophysics, and the theory of thermal ionization of elements. The grant of a foreign scholarship by the University of Calcutta enabled him to visit England in 1920–21, and to work in the laboratory of Prof. A. Fowler at the Imperial College of Science and Technology. He was thus enabled to give the finishing touches to his paper "On the Physical Theory of Stellar Spectra" which was published by the Royal Society in 1921, and is now regarded as a work of highest importance in astrophysics. When, two years later, the University of Allahabad was just then passing from an examining to a teaching university, Saha accepted the chair of physics there and was called upon to frame the courses of teaching, organize the laboratory, and initiate research work. He succeeded in creating a fine school of teaching and research under great handicaps and in infecting his colleagues with enthusiasm, resulting in important contributions to knowledge. Students trained by him have already achieved great distinction, among them being Prof. D. S. Kothari (Delhi) and Dr. R. C. Mozumdar in astrophysics; Dr. N. K. Sur in meteorology, Dr. G. R. Toshniwal in ionospheric research, and Dr. P. K. Kichlu (Lahore) in spectroscopy.

BESIDES research and teaching, Prof. Saha has taken a leading part in the organization of scientific life in India. In 1931, he was instrumental in founding an Academy of Sciences for the Provinces of Agra and Oudh. In his presidential address to the Indian Science Congress in 1934, he advocated the establishment of a National Academy of Sciences for India on the lines of the Royal Society of London. This led to the foundation of the National Institute of Sciences (composed of 150 senior scientific workers in India) at Calcutta, of which Sir Lewis Fermor was the first president. In 1937, Saha succeeded Sir H. Couchmann, the surveyor general, as president of the Institute and was able to obtain a grant for it from the Central Government. In 1935 he founded the journal *Science and Culture* with the view of educating his countrymen about the relations of science to national life in India. Through its editorials and articles, he has been advocating that large-scale industrialization is the only solution of India's problems of poverty, unemployment and defence, and has directed the attention of the public to the

necessity of nationalization of India's power resources, to the usefulness of research institutes on power, plant industry, and to the creation of national councils of industrial and scientific research. His radical views and straightforward criticisms have not rendered him a *persona grata* either with the British officials who constitute the Central Government or with the Congress, but they are gradually finding acceptance with the public.

Mr. T. A. Joyce, O.B.E.

THE approaching retirement, to take effect early in August, is announced of Thomas Athol Joyce, deputy keeper in charge of the Sub-Department of Ethnography of the British Museum (Bloomsbury). Mr. Joyce was educated at Dulwich and Hertford College, Oxford. He was appointed in 1902 to the staff of the British Museum in the Department of British and Medieval Antiquities and Ethnography, of which Mr. (later Sir) Charles Hercules Read was then keeper. Mr. Joyce during the Great War was attached to the War Office on the General Staff (Intelligence), attaining the honorary rank of captain, and being awarded the O.B.E. in 1918. In 1921, he was appointed deputy keeper of his department, and on its reorganization was placed in charge of the Sub-Department of Ethnography in 1932. In his departmental work, he had specialized in the ethnography of the peoples of Africa and the antiquities of America. His three books on the archæology of South America, Mexico and Central America, appearing between 1912 and 1916, in which the evidence available up to that time was analysed critically, secured his position as an authority among scholars in both the Old World and the New. Consequently Mr. Joyce was inevitably chosen to lead the expeditions sent by the British Museum to British Honduras in 1925 and succeeding years up to 1931, to excavate the ruined Mayan cities of that region. In addition to a large number of contributions to the publications of learned societies and the more serious of the journals devoted to the arts, such as the *Connoisseur*, Mr. Joyce was the author, in collaboration with Mr. E. Torday, of "Les Bushongo" (1910), of a valuable little book on Mayan Art (1927), and of the official guide to the ethnographical collections of the British Museum (1910). He held office as honorary secretary of the Royal Anthropological Institute in 1903–13, for two terms as vice-president, and as president (1931–33), and was president of the Anthropological Section of the British Association in 1934.

Memorial to Dr. W. J. S. Lockyer

ON July 16, at the Norman Lockyer Observatory, Sidmouth, a memorial was unveiled to the late Dr. W. J. S. Lockyer, who was director of the Observatory, in succession to his father, Sir Norman Lockyer, from 1929 until his death in 1936. The unveiling was performed by Sir Francis McClean, a personal friend of Dr. Lockyer, well acquainted with the latter's manifold activities, such as photography and aeronautics in addition to his astronomical work. Sir Robert Mond took the chair, and a speech was also made by Sir Richard Gregory who, after paying tribute to Dr. Lockyer's memory, spoke about the foundation and present position of the Observatory. The memorial (subscribed for by friends of the late director) consists first of a panel with a portrait of Dr. Lockyer in the centre surrounded by smaller portraits of those friends who have assisted in the administration and organization of the Observatory during his term of office. Beneath this panel is a cabinet containing Sir Norman Lockyer's insignia and other records of his life and work. As the subscriptions were more than sufficient to supply these two articles the balance was put towards the new 'Oxford' recording microphotometer (mentioned in NATURE of July 16, p. 108), which thus forms a part of the memorial, very suitably recognizing Lockyer's astronomical work at the Observatory. Half the cost of the microphotometer is being met by Sir Robert Mond and the other half by subscriptions to the memorial and from Observatory funds. The instrument is now completed and installed, so that the Observatory's equipment for measuring spectra is now brought up to the level of the principal observatories in Great Britain and other countries.

Record Non-Stop Formation Flight

LEAVING Cranwell at 4.15 a.m. on Thursday, July 7, four Vickers Wellesley aircraft, fitted with 'Bristol' Pegasus engines and Rotol constant-speed airscrews, flew non-stop for 32 hours. They arrived at Ismailia, Egypt, next day at 12.10 p.m., having covered a distance of 4,300 miles at an average ground-speed of 135 m.p.h. This achievement, which was part of the development work of the Long-Range Unit of the Royal Air Force, is the longest non-stop formation flight ever accomplished. A flight of this nature is an extreme test of the absolute reliability of the engines. The Pegasus engines employed were the medium-supercharged type, specially developed for economy of fuel consumption. They have to be capable of running continuously on very weak mixtures, which increases the flame temperatures in the cylinders, so that the pistons, valves, plugs, etc., are subjected to abnormally high thermal stresses. The average height during the flight was about 10,000 feet, which sets up a difficult combination of high engine gas temperatures and low air density on one hand, and operation at very low power in a cold atmosphere on the other. It is a tribute to the design, manufacture, and maintenance of these engines that they stood up to the exacting conditions of this flight, giving a continuous performance of more than a thousand horse-power for little more than a thousand pounds weight.

'Round-the-World' Flight in Northern Latitude

Mr. Howard Hughes, with Messrs. Connor and Thurlow, navigators, Stoddart, radio operator, and Lund, engineer, landed at New York on July 14, at 7.37 B.S.T. after having flown a circuit of the earth in the northern hemisphere, well above latitude

(*Continued on page* 167)

NATURE

SUPPLEMENT

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LETTERS TO THE EDITOR

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 166.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Ultracentrifugal Examination of Serum from the Lower Classes of Vertebrates

SOME time ago, a systematic investigation of the sedimentation constants of the respiratory proteins throughout the animal kingdom was carried out in this laboratory[1] with the view of finding possible relations between biological kinship and the properties of respiratory proteins.

For the vertebrates, the following results were arrived at. Hæmoglobin of practically the same sedimentation constant 4·4 (all sedimentation constants are given in units of 10^{-13}) corresponding to a molecular weight of 68,000 was found in the five higher classes, namely, Mammalia, Aves, Reptilia, Amphibia, Pisces. A respiratory protein of the erythrocruorin type, known to occur in invertebrates, and possessing a sedimentation constant of 2·0, corresponding to a molecular weight of 17,000, a quarter that of hæmoglobin, was met with in the lowest vertebrate class, Cyclostomata.

A comparative study of serum from the various classes of the vertebrates was planned in order to discover whether the regularities found for the respiratory proteins would be reflected in the properties of the serum proteins. For various reasons, this investigation was postponed until recently.

The sera of various mammals (man, horse, cow, pig and rabbit) have been subjected to detailed investigation by means of the ultracentrifugal method[2]. In diluted sera, two principal components with sedimentation constants, $s = 4{\cdot}5$ and $7{\cdot}1$, were found, corresponding to an albumin of molecular weight $M = 69{,}000$ and to a globulin of $M = 160{,}000$, respectively. A higher globulin component of $s = 18$ and M of about six times that of normal globulin often occurred.

The serum of Aves (hen) give the same general sedimentation diagram as that found for the mammals[3]. We have recently made some preliminary runs on sera from the classes Reptilia, Amphibia, Pisces and Cyclostomata with the following results. The sedimentation diagram shows in the case of Reptilia (snake), Amphibia (frog), and Pisces (*Abramis brama*) the existence of a component corresponding to the albumin of the higher vertebrates and two components which probably correspond to the globulins. The serum from Cyclostomata (*Lampetra fluviatilis*), however, is definitely different. A component of $s = 3{\cdot}5$ and another of $s = 12$ predominate. The former probably has a molecular weight about half that of the serum albumin of the higher vertebrates.

The measurements carried out so far seem to indicate, therefore, that, on the whole, the protein components in the sera from Mammalia, Aves, Reptilia, Amphibia and Pisces are similar with regard to molecular state, while those from Cyclostomata differ considerably in this respect.

A more detailed account of the investigation will be given elsewhere.

THE SVEDBERG.
KJELL ANDERSSON.

Institute of Physical Chemistry,
University, Uppsala.
June 14.

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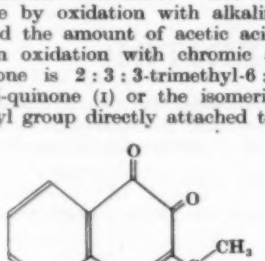
[3] Pentimalli, F., and Pedersen, K. O., unpublished data.

A New Natural Colouring Matter of the Naphthalene Group

S. SIDDIQUI has recently described[1] the isolation of three new colouring matters, occurring together as a reddish dust on the leaves of *Didymocarpus pedicellata*. In view of this publication, we now place on record the preliminary results of work in progress on the constitution of a colouring matter different from, but perhaps related to, Siddiqui's, and occurring as a deposit on the leaves and inflorescences of *Streptocarpus Dunnii* Mast., a member of a genus closely related to *Didymocarpus*[2].

The new pigment, for which we propose the name *dunnione*, crystallizes in orange-red needles, m.p. 98–99°, from light petroleum or water, and has the molecular formula $C_{13}H_{14}O_3$. Its physical and chemical properties and the results of degradative experiments, including the formation of phthalic acid in oxidation processes, show it to be a β-naphthaquinone derivative. The third oxygen atom is neither hydroxylic nor ketonic, and the behaviour of dunnione towards alkalis indicates that the oxygen atom is a member of an easily ruptured chromane or coumarane ring. Acidification of the alkaline solution obtained under certain conditions does not regenerate dunnione but a new substance which is probably an α-naphthaquinone derivative. The formation of acetaldehyde by oxidation with alkaline hydrogen peroxide and the amount of acetic acid (1·6 mol.) produced on oxidation with chromic acid suggest that dunnione is 2 : 3 : 3-trimethyl-6 : 7-benzocoumarane-4 : 5-quinone (I) or the isomeride with the gem-dimethyl group directly attached to oxygen.



(I)

This is supported by the close agreement of the properties of dunnione and 2 : 3-dimethyl-6 : 7-benzocoumarane-4 : 5-quinone, which has been synthesized by Fieser[3].

A more complete account of this investigation will be published elsewhere.

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R. Robinson.

Dyson Perrins Laboratory,
Oxford.

[1] *J. Indian Chem. Soc.*, **14**, 703 (1937).
[2] *Cf.* Robinson and Robinson, *Biochem. J.*, **28**, 1718 (1934).
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Hæmocuprein, a Copper-Protein Compound of Red Blood Corpuscles

That copper is present in human blood has been known since 1875[1]. Its concentrations in the red blood corpuscles and serum of man and different animals, at different ages, under normal and pathological conditions, have been estimated by several workers[2,3]. Very little has been known, however, as to the state in which the copper is present in the blood.

The object of this investigation was to ascertain whether the copper present in the red blood corpuscles of mammals is free as an inorganic salt, or is combined with an organic substance.

The mere fact that the copper cannot be removed from a solution of plasmolysed red blood corpuscles by a very prolonged dialysis makes the possibility of its presence in the form of an inorganic salt very doubtful. That this copper is bound to a protein we are now able to demonstrate by isolating from the red blood corpuscles of the ox a pure crystalline copper-protein compound.

The main steps of isolation and purification of this compound are as follows: Red blood corpuscles of ox, after a thorough washing with salt solution, are plasmolysed with distilled water and treated with an alcohol chloroform mixture. The hæmoglobin-free solution which is filtered off contains most of the copper present in the corpuscles. This solution is treated with lead acetate, the precipitate being eluted with alkaline phosphate, dialysed, and the impurities removed with tricalcium phosphate. The clear solution is then precipitated with acetone, dissolved in water, fractionated by adsorption on alumina cy and dialysed. The clear and distinctly bluish solution thus obtained, on treating with alcohol, becomes opalescent, and on standing in the cold yields, within a short time, bluish crystals of a copper-protein compound. These crystals easily settle down forming a distinctly blue sediment. The analysis of the crystals shows 14·35 per cent nitrogen, 1·12 per cent sulphur and 0·34 per cent copper.

The copper-protein compound thus obtained, for which we propose the name of *hæmocuprein*, forms a fourth organic copper compound known in living organisms. Of the three other compounds, hæmocyanine and polyphenol oxidase are copper-protein compounds, while turacin is a copper-uroporphyrin compound.

We have found that in serum also the copper is present as a blue copper-protein compound very similar to hæmocuprein. Its identity with the latter will, however, be ascertained when this compound will be isolated in a pure state.

A more detailed account of the purification, properties and relationship of hæmocuprein to the copper of serum and tissues will be published elsewhere.

T. Mann.
D. Keilin.

Molteno Institute,
University, Cambridge.
June 29.

[1] Porter, J. A., "Principles of Chemistry" (New York, 1875), 333 (from Sachs, A., *et al.*, 1935).
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A Hæmoglobin from Bile Pigment

When a solution of hæmoglobin and ascorbic acid in alkaline phosphate or in phosphate buffer of *p*H 7·6 is exposed to air at 20° for 48 hours, the solution shows an absorption band in the red (at about 674 mμ). On reduction by hyposulphite, this band is replaced by a strong band at 629 mμ[1]. By denaturation of the globin by alkali or pyridine, a hæmochromogen with an absorption band at 619 mμ is obtained. The latter is identical with the "α-pseudohæmoglobin" of Barkan and Schales[2]; in the preparation of these authors the denaturation is caused by the strong alkalinity of the cyanide solution.

At higher temperatures the conversion of hæmoglobin to these substances is much more rapid, but the oxidation of the prosthetic group is accompanied by a progressive oxidative denaturation of the globin part of the molecule. This causes at first the formation of an alkali-soluble green precipitate and ultimately of alkali-insoluble compounds. In such products[3] the prosthetic group becomes condensed

into the denatured protein, so that it can no longer be removed. Splitting with amyl alcohol and mineral acids results in pigments still containing peptide residues.

We have been able to remove the prosthetic group from the undenatured compound and to isolate the iron-free compound in the pure state. The solution displaying the band at 629 mμ is precipitated by ammonium sulphate, and the precipitate is digested with a mixture of two parts of ethyl acetate and one part of glacial acetic acid. This solution is diluted with ether, washed and filtered. It contains some protohæmatin, but no longer the hæmatin which gives the hæmochromogen with the band at 619 mμ. One per cent hydrochloric acid extracts biliverdin hydrochloride, while a weakly basic biliviolin is extracted by 25 per cent hydrochloric acid. From the first extract we have prepared crystalline *biliverdin* and *biliverdin dimethyl ester* and have identified the latter with an ester prepared from bilirubin by melting point and mixed melting point (216° F. on the copper block), crystal forms and other properties. The nature of the splitting products and the readiness with which iron is split off under conditions in which no trace of porphyrin or bile pigment is obtained from crystalline hæmin, prove that the prosthetic group of the new hæmoglobin is a bile pigment - iron compound, closely related to verdohæmatin[4], while the fact that its hæmochromogen differs from verdohæmochromogen shows that it is not verdohæmatin. The name choleglobin is suggested for the new hybrid hæmoglobin, and the name cholehæmochromogen for its hæmochromogen.

At present we are unable to say in which way the prosthetic groups of choleglobin and of verdohæmochromogen differ in constitution. Choleglobin is readily obtained by the action of dilute hydrogen peroxide on a solution of hæmoglobin containing ascorbic acid; hydrogen peroxide thus plays a part in the formation of choleglobin similar to that in the formation of verdohæmochromogens from hæmochromogens[5], but the qualitative influence of the globin in the constitution of the prosthetic group, arising from hæm on oxidation, is remarkable.

It is of interest to compare the properties of the new hybrid hæmoglobin with those of hæmoglobin. It appears to unite with oxygen and with carbon monoxide reversibly. The compound with the band in the red appears to be oxycholeglobin, since it can be transformed into choleglobin by evacuation even after removal of all reducing substances by dialysis, and since it is reformed by aeration. Carbon monoxide choleglobin and carbon monoxide - cholehæmochromogen possess the same absorption band (at 629 mμ), as do carbon monoxide - hæmoglobin and carbon monoxide - hæmochromogen, while they differ in their stability to oxygen. Whereas carbon monoxide-cholehæmochromogen is readily decomposed on aeration, carbon monoxide - choleglobin is only slowly converted to oxycholeglobin by oxygen. Incidentally, these observations prove again the identity of the prosthetic group in choleglobin and cholehæmochromogen. It is expected, however, that the carbon monoxide - choleglobin band should coincide with that of reduced choleglobin. This fact complicates the investigation of the reaction of choleglobin with carbon monoxide, but the study of the conditions under which the band at 629 mμ appears in the absence and in the presence of carbon monoxide has satisfied us that carbon monoxide - choleglobin exists.

A small amount of biliviolin is formed when oxygenated laked horse or sheep corpuscles are subjected to the treatment with the ethyl acetate - glacial acetic acid mixture, while a somewhat larger amount of biliverdin is formed when the digestion mixture is added to the exhausted solution of laked corpuscles under nitrogen. While these experiments support the claim of Barkan and Schales that bile pigment hæmatin compounds occur in erythrocytes, we have been unable to find evidence for the presence of choleglobin in erythrocytes, although our experiments show that choleglobin is very readily formed from hæmoglobin. Its absorption band at 629 mμ (shifted to 619 mμ on denaturation) becomes visible on addition of hyposulphite to oxygenated laked erythrocytes, but on reduction by evacuation or by hyposulphite in the absence of oxygen only a band in the red (at about 660 mμ) can be seen in addition to the band of reduced hæmoglobin (cf. also ref. [1]). The band in the red is not shifted on denaturation by pyridine, but it is abolished by oxygen or by carbon monoxide. It may, therefore, belong to the bile pigment hæmatin compound present in the erythrocytes, and to judge from its position, it may be that of a verdohæmatin compound. These experiments, while still leaving undecided the exact nature of the hæmatin compound contained in bile pigment, leave little doubt that such compounds are intermediates in the breakdown of hæmoglobin.

The work described above has been carried out with a grant from the National Health and Medical Research Council of Australia.

R. Lemberg.
J. W. Legge.
W. H. Lockwood.

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Royal North Shore Hospital,
Sydney.
May 29.

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Isolation of a Flavin-Protein Compound from Milk

We have been able to prepare a flavin-protein compound from cow's milk by the following procedure: (1) half-saturation with ammonium sulphate of the whey of rennin-treated milk; (2) ether extraction of the dried precipitate; (3) reprecipitation by 33 per cent saturation of the solution of the redissolved precipitate with ammonium sulphate at *p*H 4·0 and 0°; (4) elimination of the fraction insoluble in 25 per cent saturated ammonium sulphate at *p*H 4·0 and in presence of 10 per cent alcohol; (5) adsorption on and elution from alumina cγ[1] followed by ultrafiltration and further fractionation with ammonium sulphate.

The orange yellow powder so obtained in a yield of about 1 gm. from 30 litres of milk dissolves to form a clear aqueous solution. The orange colour is discharged by addition of hyposulphite and restored by shaking with air. The absorption spectrum shows a broad band in the visible with a peak at 460–465 mμ. By treatment with 75 per cent methanol the coloured prosthetic group can be split off from the colourless protein. A solution of the prosthetic group shows the typical greenish fluorescence of flavin and also

the reversible reduction with hyposulphite. The absorption spectrum is practically identical with that of riboflavin[2] (peaks of the three absorption bands at 270, 360 and 445 mμ respectively). The fact that the prosthetic group is insoluble in benzyl alcohol indicates that it is not riboflavin but more likely the corresponding phosphorylated compound[3].

Milk flavoprotein was found to catalyse the oxidation of reduced coenzyme I (prepared by reduction either with dehydrogenase systems or with hyposulphite) by carriers such as methylene blue, riboflavinphosphate and cytochrome *c*. Calculation showed that in presence of a large excess of reduced coenzyme I, each molecule of milk flavoprotein catalysed the oxidation by methylene blue of about a thousand molecules of reduced coenzyme per minute at 38°. A positive catalytic effect was observed with as little as 0·02 γ flavin equivalent per ml.

In the course of its catalysis, milk flavoprotein did not appear to undergo a cycle of reduction and oxidation. This consideration leads us to believe that milk flavoprotein acts catalytically not by serving as an intermediary between reduced coenzyme and the carrier, but rather by forming a complex with the reductant and the oxidant and thereby facilitating the transfer of hydrogen.

Since our best preparations contain only 0·06 per cent flavin contrasted to 0·6 per cent in the purest preparations of yeast flavoprotein, the possibility still exists that the catalytic effects observed may be due to some persistent colourless impurity. However, the parallelism between catalytic activity and concentration of flavoprotein makes the impurity hypothesis unlikely.

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Biochemical Department,
Cambridge. June 18.

[1] Weygand and Stocker, *Hoppe-Seyl. Z.*, **247**, 167 (1937).
[2] Kuhn *et al.*, *Ber.*, **66**, 1035 (1933).
[3] Emmerie, NATURE, **141**, 416 (1938).

A New Enzyme of the Glycosidase Type

I SHOULD like to report the occurrence of what appears to be a new enzyme of the glycosidase type.

This ferment, which is readily prepared from celery seed using Tauber's technique,[1] hydrolyses naringin, the bitter glycosidic principle of grape-fruit (*Citrus decumana*) *in vitro* at 37° and *p*H 7. The products are the insoluble aglycone naringenin (or naringetol) in crystalline aggregates belonging to the hexagonal system (I mention this because I have seen no reference to its crystalline form, and have myself only succeeded in producing the amorphous form together with glucose and rhamnose by acid hydrolysis of naringin), and in addition, a seemingly new disaccharide. That this latter is not rutinose (β . 1 . rhamnopyranosido - 6 . *d* . glucopyranose) follows from the work of Rabaté,[2] whose results I have confirmed, namely, that rhamnodiastase, the enzyme which removes rutinose from its glycosides, will not decompose naringin. Further, since repeated attempts to hydrolyse naringin with emulsin have failed, it is probable that the disaccharide is akin to rutinose but has an α- instead of a β-linkage between its constituent sugars, or the only alternative, that it is glucosidorhamnose, the aglycone linkage being through rhamnose instead of glucose.

It is hoped to establish this definitely later on, and meanwhile it is interesting to record yet another instance of the occurrence together in the same species, but not necessarily in the same organ, of substrate and enzyme, which latter can be prepared from the leaves of the tree *Citrus decumana*, again using Tauber's method. The enzyme is absent from the rag, peel and seeds of the fruit, but occurs in small amount immediately between the flavedo and albedo, where very possibly it plays some part in ripening, since it is known that the bitterness then decreases in the fruit.

It would seem, therefore, that this represents the first occasion on which naringin has been hydrolysed by an enzyme *in vitro*, and possibly this new enzyme can be employed to study further the metabolism of rhamnosides in plants.

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[1] Tauber, *J. Biol. Chem.*, **99**, 257 (1932).
[2] Rabaté, *Bull. Soc. Chim. Biol.*, **17**, 314 (1935).

Quantitative Measurement of Vitamin B_1 by the Thiochrome Reaction

IT has been known to us for more than a year that there is a large discrepancy between the results of biological vitamin B_1 assay and of determination of aneurin by the original method of Jansen[1], when both methods are applied to animal tissues. We did not like to report on these observations before having succeeded in determining vitamin B_1 quantitatively by the thiochrome method. Immediately after the publication of a paper by M. A. Pyke[2], however, it was clear to us that he had estimated only a very small part of the total amount of vitamin B_1 actually present in the animal tissues investigated. Dr. Pyke's letter in NATURE of June 25, p. 1141, prompts us to make the following remarks.

Westenbrink and Jansen[3] described the determination of the two forms of vitamin B_1 known with certainty up to this moment, aneurin and cocarboxylase or aneurin-pyrophosphoric acid, separately by means of the thiochrome method at the meeting of the Dutch Society of Physiology and Pharmacology of April 2, 1938. This method is based on the fact that thiochrome formed from aneurin is extracted quantitatively from the aqueous reaction mixture by isobutanol, whilst the thiochrome-pyrophosphoric acid formed from cocarboxylase remains quantitatively in the aqueous layer[4].

Since that time we have applied this method to various animal tissues. When the tissues are finely minced and suspended in water and vitamin B_1 is absorbed on franconite at *p*H 3, the aqueous and isobutanol layers both show a blue fluorescence even without oxidation by ferricyanide. In most cases this 'blank' fluorescence is even stronger than the fluorescence observed after oxidation of the vitamin by ferricyanide. However, the 'blank' fluorescence may be reduced to a very small remainder by digesting the tissue proteins by pepsin, previous to the adsorption of the vitamin on franconite.

After this observation we were able to carry out aneurin and cocarboxylase determinations in animal tissues. Certainly the method is still capable of improvement, but it was sufficiently accurate already to provide the following results :

The aneurin content of animal tissues is very small as compared to their cocarboxylase content; for example, normal rat's tissues: liver, 7–13 μgm. cocarboxylase, less than 2 μgm. aneurin; muscle, 1·5–5 μgm. cocarboxylase, less than 0·5 μgm. aneurin; kidney, 11 μgm. cocarboxylase, 0·5 μgm. aneurin; brain, 6 μgm. cocarboxylase, less than 0·3 μgm. aneurin. The results obtained with normal pigeon's tissues were essentially the same. Tissues of rats which had lived for three weeks on a diet free from vitamin B_1 only contain a very small amount of this vitamin; ten minutes after subcutaneous injection of a large amount of aneurin, however, liver and kidney contained again a large amount of cocarboxylase besides an abnormally high amount of aneurin. No increased amount of aneurin was observed in muscle and brain, hence injection of aneurin does not flood the whole organism with this substance.

These investigations are fully described in a paper to be published in *Enzymologia*.

We are much indebted to Prof. K. Lohmann, of Berlin, who kindly sent a specimen of crystalline cocarboxylase to Prof. B. C. P. Jansen, director of this laboratory, whom we wish to thank for his interest in our work.

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J. Goudsmit.

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June 27.

[1] Jansen, B. C. P., *Rec. Trav. chim.*, **55**, 1046 (1936); see for application on urine and aneurin metabolism problems: Westenbrink, H. G. K., and Goudsmit, J., *Rec. Trav. chim.*, **56**, 803 (1937); *Nederl. Tijdschrift Geneeskunde*, **81**, 2632, 4056 (1937); **82**, 518, 1076 (1938); *Arch. Néerl., Physiol.*, **22**, 319 (1937). **23** (in the Press).

[2] *Biochem. J.*, **31**, 1958 (1937).

[3] Westenbrink, H. G. K., and Jansen, B. C. P., *Acta brevia neerl.*, **8**, 119 (1938).

[4] See also Kinnersley, H. W., and Peters, R. A., *Biochem. J.*, **32**, 697 (1938).

Occurrence of Acetylcholine in Nervous Tissue of Crustaceans and its Effect on the Crab Heart

Contrary to the belief of certain investigators[1,2], acetylcholine occurs in some tissues of decapod crustaceans in considerable amounts. Trichloracetic acid extracts of leg nerves and ventral ganglia of *Carcinus* indicate a difference in the distribution of acetylcholine in these two tissues which is in close agreement with the distribution of choline esterase in the ventral ganglia and longitudinal commissures of the lobster, *Homarus*. In this form it has been shown[3,4] that two to four times as much choline esterase is present in the ventral ganglia as in the rest of the cord, which consists of fibres, with few, if any, nerve endings. In *Carcinus* there is approximately five times as much acetylcholine in the ventral ganglia as in the leg nerves.

Studies of neuromuscular transmission in crabs[5] indicate that acetylcholine is probably not the mediator between nerves and skeletal muscle in these animals. It has been found, however, to have a marked effect on the heart, and its action is the reverse of that on the vertebrate heart. In low concentrations it increases the rate of beat of the isolated heart of *Carcinus* and *Maia*, and in high concentrations it produces tetanus and systolic stoppage. The active material from 0·1 mgm. of ventral ganglion or 0·5 mgm. of leg nerve, per cubic centimetre of perfusion fluid, is usually sufficient to increase to more than double the frequency of beat of the isolated heart.

Since adrenalin and acetylcholine both accelerate the decapod heart when administered in small doses, it is possible that the accelerator nerves to the heart normally produce one of these substances.

A more detailed account of this work, which was done at the Marine Biological Laboratory, Plymouth, and the Zoological Laboratory, Cambridge, will appear elsewhere.

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[1] Bacq, Z. M., *C.R. Soc. Biol., Paris*, **120**, 247 (1935).

[2] Bacq, Z. M., *Proc. Roy. Soc.*, B, **123**, see p. 418 of Discussion on the Transmission of Excitation (1937).

[3] Marnay, A., and Nachmansohn, D., *C.R. Soc. Biol., Paris*, **125**, 1005 (1937).

[4] Nachmansohn, D., *C.R. Soc. Biol., Paris*, **126**, 783 (1937).

[5] Katz, B., *J. Physiol.*, **87**, 14 (1936).

Dormant Life of Tumour Cells in the Animal Body

Working with transplantations of Ehrlich mouse carcinoma (belonging to a strain cultivated *in vitro* in this Institute for nearly twelve years), we observed that tumours developed in general after two to four weeks. These experiments were carried out on ordinary commercial white mice, all of male sex. The body-weight was 13–20 gm. In several cases we found, however, that tumours developed 6 weeks and even 8, 10, 12 and 16 weeks after the inoculation of the carcinoma cells.

These findings seem to be of interest in regard to "The theory of the developmental physiology of malignant tumours" recently put forward by A. Fischer[1]. From his experiments, Fischer has drawn the following conclusion: "The cancer cell may already be present in the body and needs only what may be termed a realization factor in order to develop into a malignant tumour". Such a factor may be, according to Fischer, old age, chronic proliferative activity, influence of hormones, etc. Our observations that cancer cells may lie dormant for a long period of time before they manifest themselves as a tumour, seems to support the theory of Fischer.

The observation of a latent life of tumour cells for a period up to 16 weeks in the body of white mice may be significant in consideration of the fact that it amounts to one sixth of the whole life of a mouse. In comparison with the duration of human life, it would mean a period of dormant life of tumour cells of ten years, a period which is in very good agreement with our experience of the development of X-ray carcinoma.

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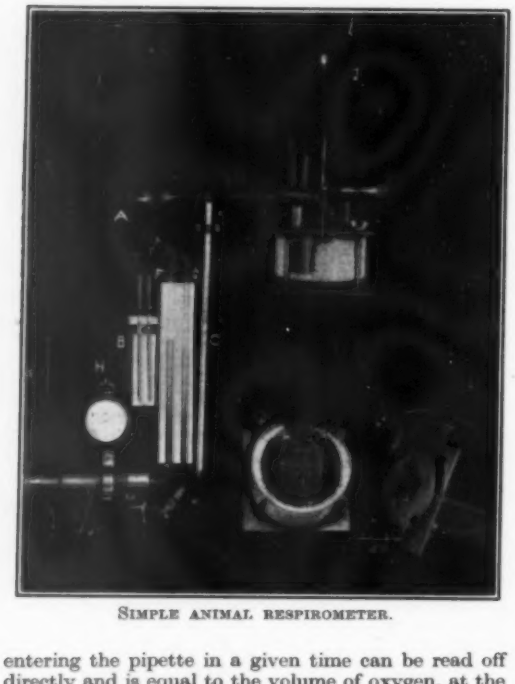
[1] Fischer, A., *Amer. J. Cancer*, **31**, 1 (1937).

A Simple Respirometer for Small Animals

In the course of some work carried on in this laboratory, it became necessary to devise an apparatus that would measure oxygen consumption during the early life of the mouse. Most of the available methods are either elaborate in technique and equipment or ill-adapted for use with small animals. However, a constant-pressure type of respirometer, after the principle used by Winterstein and later described by

Dixon[1] has been successfully adapted to the problem and might well be given wider application. Materials for its construction are readily available, and it is so sensitive that determinations may be made over very short periods—½–4 minutes. Mice are seldom absolutely quiet for longer periods, and so this sensitivity is almost a necessity when working with these animals.

The constant-pressure respirometer has not been widely used although its simple theory makes calculations extremely easy and calibration unnecessary. It consists of a chamber and a recorder. The carbon dioxide is absorbed by some suitable agent and the decrease in pressure resulting from consumption of oxygen is recorded on a sensitive manometer. Mercury is forced into a calibrated pipette connected in the system until the manometer again records atmospheric pressure. The amount of mercury



SIMPLE ANIMAL RESPIROMETER.

entering the pipette in a given time can be read off directly and is equal to the volume of oxygen, at the recorded temperature and pressure, consumed by the organism. The volume is then corrected to N.T.P.

The temperature of the chamber must be maintained accurately by a water bath thermostat, and though the air in the recorder need not be at the same, it must be kept at a constant temperature (recorded by thermometer *C*). It is convenient to maintain the room and water bath at the same temperature, for the animal can then be easily adapted in the room and readings taken soon after the respirometer is placed in the bath.

The recording apparatus is arranged so that readings may be made at convenient time intervals until 3 c.c. of oxygen have been consumed. Dry air is then sucked through the chamber for several minutes to restore the oxygen pressure. As this air must be at the same temperature as the bath, it is passed through an immersed copper coil before entering the chamber. The loss of 3 c.c. of oxygen will not change the amount in the chamber by more than 1–2 per cent and such small changes in the partial pressure of oxygen have been shown to have little effect on oxygen consumption. All readings are made in the 1 c.c. pipette *G*, the mercury being controlled by the 1 c.c. syringe *E*. As soon as the air in this pipette is exhausted, the mercury is lowered gradually, while 1 c.c. of air is drawn over at constant pressure from the 5 c.c. pipette *F*. The mercury in *F* is controlled by syringe *D*. This process is carefully carried out during a determination, so no time is lost. Manometer *B* contains kerosene stained with Sudan III. The three-way stop-cock *A* allows the connexion of the chamber, the recorder and the outside while equilibrium is attained and the isolation of the chamber and recorder during a determination. The stop-watch *H* is placed on the recorder for convenience. Two or more chambers may be used with one recorder.

The chamber of the respirometer is a 350 c.c. thin-walled glass crystallizing dish fitted between two brass plates, the top made water-tight by a rubber gasket. The chamber is protected by a sponge rubber base. A round wire frame fitted with wire screening and having a diameter 1·5 in. less than the chamber is placed inside. The space between it and the glass wall is filled with fine mesh soda lime. Concentrated sulphuric acid placed in a small vial absorbs moisture. A hole is left in the wire net so that movements may be watched. Within the chamber is placed a wire cage containing the animal. The size of this cage depends upon the animal, and should allow free movements though confined to a small space. Cotton placed beneath the cage adds to the animal's comfort and absorbs excreta.

The brass top is furnished with three outlets. The central one contains a shaft with a propeller serving to keep the air of the chamber in motion. The bearing, if well greased through a small cup on the side, will easily hold the slight differences in pressure which are allowed to exist during a determination. A small flexible shaft or steel spring allows connexion with a motor, the speed of which can be carefully controlled through a rheostat. 150–200 rev. per min. is sufficient and will not disturb the animal; but the speed used should first be shown to produce air currents small enough to have no effect upon the manometer.

Another outlet provided with a stop-cock leads to a section pump which serves to ventilate the chamber. Connexion to the recorder is by means of a second stop-cock which can also connect the chamber through the copper coil to the outside. The incoming air is dried with calcium chloride before it enters the coil.

Readings for convenient intervals are taken until a sufficient number of checks give the experimenter confidence that he is dealing with a true basal state. Movements usually produce enough heat to expand the gas in the chamber and affect the manometer, so there is little chance of including the readings obtained during periods of movement in the final average.

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[1] Dixon, "Manometric Methods" (1934).

Substitution of Cysteine for Protohæmin as the 'X' Factor for Growth of *H. influenzæ*

THE indispensability of iron in the form of protohæmin, the so-called 'X' factor, to the growth of *H. influenzæ* has long been an accepted fact. Recently, the Lwoffs observed that the oxygen consumption of suspensions of this organism containing minimal amounts of hæmin is remarkably increased by the addition of small quantities of this compound. Accordingly, they concluded that the 'X' factor functions by supplying, to the cell, material from which it can synthesize a catalytic respiratory system comprising cytochrome *C* and possibly cytochrome oxidase, peroxidase and catalase, although no direct evidence was advanced for the latter[1]. If there is a correlation between the necessity of the hæmin for growth and its ability to promote oxygen consumption, it should be possible to grow the influenza bacillus by replacing the iron complexes with any other system which is capable of inducing oxygen consumption. Since reversible oxidation-reduction systems of suitable potential can function as efficient respiratory catalysts[2], we set out to determine the effect of these systems on the growth of *H. influenzæ*.

Those dye systems, within the potential range which has been demonstrated to be most effective in respiratory catalysis, failed to support growth when added to a basic medium to which adequate amounts of 'V' (yeast extract) were added. Moreover, they actually inhibited growth even in the presence of the minimal amounts of protohæmin found necessary to support serial transfer (10^{-6} gm./c.c.). This inhibition was traced to the accumulation of hydrogen peroxide resulting from the activity of the supplementary dye catalyst.

Since cysteine is effective in protecting cells from the inhibitory activity of peroxide[3], it should thus protect the organism from the inhibitory action of the dyes. Experiments proved this to be the case. Furthermore, cysteine plus suitable dyes effectively replaced hæmin as a growth requirement, and this combination supported growth in successive serial transfers. Moreover, cysteine alone was found to be capable of permitting serial growth. Whereas in the absence of hæmin, the sulphhydryl compound was required for aerobic growth, its presence was unnecessary for anaerobic growth. This confirms the results of Anderson[4] who found that only the 'V' factor is required under anaerobic conditions.

Since anaerobic growth can occur, it is evident that oxygen consumption is not essential for multiplication. Further, since respiratory catalysts (dyes) alone cannot support growth, it is obvious that the 'X' factor cannot be replaced by a system which functions solely as a respiratory mechanism. However, since cysteine alone can replace hæmin, and, in the latter's absence, is necessary for aerobic but not for anaerobic growth, it becomes probable that the sole necessary function of either of these substances is to provide the organism with a mechanism for protection against hydrogen peroxide, formed under aerobic conditions through the activity of a non-hæmin respiratory system. Thus, *H. influenzæ*, in the absence of the 'X' factor, is physiologically similar to *E. coli* in the presence of cyanide and methylene blue[5], since both organisms, under these conditions, possess mechanisms for the formation of peroxide but none for its destruction. The role of hæmin is to supply this missing mechanism in the form of catalase. These experiments do not deny the role of hæmin in promoting respiration, but merely point out that such a function is unnecessary and incidental to its principal action.

The foregoing results will be presented in more detail elsewhere.

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[1] Lwoff, A., and Lwoff, M., *Ann. Inst. Pasteur*, **59**, 129 (1937).
[2] Barron, E. S. G., and Hoffman, L. A., *J. Gen. Physiol.*, **13**, 483 (1930).
[3] Quastel, J. H., and Wooldridge, W. R., *Biochem. J.*, **23**, 115 (1929).
[4] Anderson, L. R., *Amer. J. Hyg.*, **13**, 164 (1931).
[5] Broh-Kahn, R. H., and Mirsky, I. A., *J. Bact.*, **35**, 455 (1938).

Composition of the Aerial Insect Fauna up to 300 ft.

IN a recent letter in NATURE (April 2) on the aerial drift of insects up to 2,000 ft., Hardy and Milne make reference to the intensive study of such drift at lower levels by flying 3-ft. diameter nets simultaneously (usually for 3 hours round about midday) at heights of 277 ft., 177 ft. and 10 ft., on each of three masts placed along a 5/6 mile frontage at the Beam Wireless Station, Tetney, North Lincolnshire. A brief note of the principal findings may be of interest.

Thirty-one series of collections were made from March until November during 1934 and 1935 yielding 2,896, 4,740 and 15,659 insects belonging to 166, 197 and 298 species at the top, middle and bottom heights respectively, a total of 23,295 insects of 421 species. Most were winged adults of small size; but a number of nymphs (Hemiptera) and true apterous forms (Collembola and Psocoptera), in addition to 134 spiders (20 species) and parts of plants (31 species) were taken. Species of seven genera made up more than 50 per cent of the numbers collected: *Brevicoryne brassicæ* L. (cabbage aphis) (3,334 individuals), *Sciara* spp. (2,484), *Pterodela pedicularia* L. (2,357), *Oscinis* spp. (frit flies) (1,708), *Aphidius* spp. (1,522), *Leptocera* spp. (967), *Limothrips cerealium* Hal. and *denticornis* Hal. (corn thrips) (402).

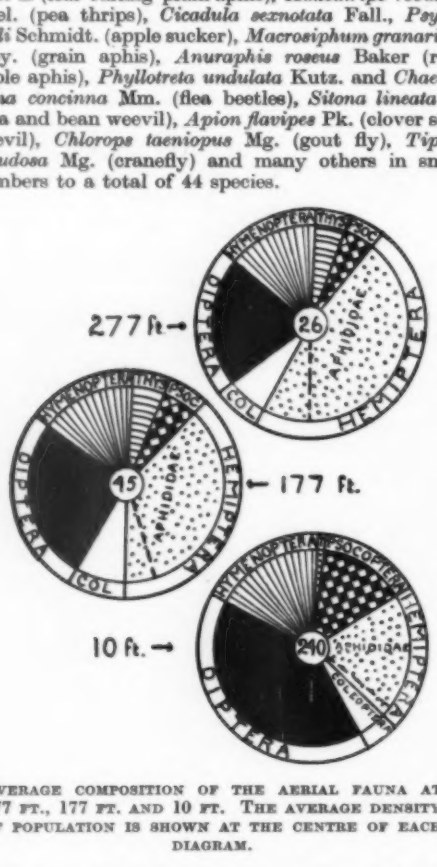
The average 'density of insect population', defined as the number of insects in one million cubic feet of air, declined with height, so that 75 per cent of the total population was below 100 ft. Diptera was the most numerous order up to that height and Hemiptera above. Aphididæ were the dominant family at all heights. The average composition of the fauna at each height is shown in the accompanying diagram.

The distribution of population across the front was even although local aggregations occurred in nets, especially at ground-level, often owing to the close proximity of host plants upwind. The greatest numbers and variety occurred during the months of June and September, when insects are most active in breeding and dispersal.

The most favourable conditions for the maximum numbers in the air varied from family to family, but in general the greatest numbers of all insects occurred at relative humidities below 59 per cent, at surface wind velocities below 9 m.p.h. and at

temperatures above 64° F., the latter factor exercising most control.

In addition to the pests already mentioned, others also taken up to 277 ft. were : *Myzus* spp., *Anuraphis padi* L (leaf curling plum aphis), *Kakothrips robustus* Uzel. (pea thrips), *Cicadula sexnotata* Fall., *Psyllia mali* Schmidt. (apple sucker), *Macrosiphum granarium* Kby. (grain aphis), *Anuraphis roseus* Baker (rosy apple aphis), *Phyllotreta undulata* Kutz. and *Chaetocnema concinna* Mm. (flea beetles), *Sitona lineata* L. (pea and bean weevil), *Apion flavipes* Pk. (clover seed weevil), *Chlorops taeniopus* Mg. (gout fly), *Tipula paludosa* Mg. (cranefly) and many others in small numbers to a total of 44 species.



AVERAGE COMPOSITION OF THE AERIAL FAUNA AT 277 FT., 177 FT. AND 10 FT. THE AVERAGE DENSITY OF POPULATION IS SHOWN AT THE CENTRE OF EACH DIAGRAM.

The presence of large numbers of insects in the air throughout the greater part of the year indicates the important part played by wind carriage in their dispersal. The observations also invite speculation as to the efficiency of ground quarantines in preventing the widespread distribution of insect pests.

The work was initiated by Prof. A. C. Hardy and carried out by me under his direction during part of the tenure of an agricultural research scholarship of the Ministry of Agriculture and Fisheries. A full report will be published elsewhere.

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June 18.

A New Test Plant for Potato Virus Y

HITHERTO the most convenient test for the presence of potato virus Y (*Solanum* virus 2) has been by sap inoculation to tobacco, and no plant has been recorded on which the virus produces local lesions visible without decolorizing the leaf and staining with iodine.

While investigating the host range of potato viruses on solanaceous plants it was recently found that virus Y induces abundant brown circular local lesions about ten days after inoculation to leaves of *Lycium barbarum* seedlings. When these lesions are very numerous, they are followed by wilting and abscission of the inoculated leaves, but no systemic infection of the plant results. The latter fact was confirmed both by inoculation to tobacco from the non-inoculated portion of the *Lycium* plant and by grafting it to healthy potato varieties highly susceptible to virus Y. The characteristic local lesions resulted from inoculation with standard virus Y, with a slightly different strain recovered from *Schizanthus*[1] and with virus HY II[2], and were freely induced by strains of Y no longer readily sap-inoculable to tobacco. Sap from Y-infected potato, tobacco and *Schizanthus* plants proved equally effective.

No other virus so far tested has induced a similar reaction, although faint local rings may result from inoculation of *Lycium* with necrotic strains of viruses X and B. No visible lesions result from inoculation with weak strains of X or with potato viruses A, F, G, and the virus of cucumber mosaic. A rather bright yellow mottling of the leaves follows infection with tomato aucuba mosaic, and this virus was readily recovered from the inoculated leaves. There is no evidence of systemic infection of *Lycium* with any of the above viruses. Inoculation to *Lycium* cannot be used to separate virus Y from a mixture of X and Y. The effect of virus A on *Lycium* was tested by inoculation from an infected potato plant, a host from which it is not readily sap-transmissible; the other viruses were taken from infected tobacco plants.

It is possible that the reaction may prove of value as a test for virus Y, especially when that virus is present in plants other than tobacco.

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[1] Salaman, R. N., NATURE, **139**, 924 (1937).
[2] Hamilton, M. A., *Annals of Applied Biology*, **19**, 550–567 (1932).

The Florisbad and Taungs Skulls

'GOOD wine needs no bush'; nevertheless South African anthropologists are very grateful to Sir Arthur Keith for his unfailing interest in their work and particularly for his recent note on the Florisbad skull[1]. It is, as Sir Arthur says, an outstanding landmark in human palæontology, and well worthy of sharing attention with Rhodesian man. But just as there is little agreement about the exact position of the latter in the human scale, so the status of Florisbad man is not yet settled.

Sir Arthur takes the same view as one South African school, and regards Florisbad man as the successor of Rhodesian man and the immediate forerunner of Boskop man. There is a good deal to be said for the first part of this contention, as the brow ridges of the Florisbad skull are only a little less massive and they have only a slightly shorter span than the Rhodesian torus. I find it difficult, however, to link this feature with the vertical forehead of the Boskop skull, as the doyen of British anatomists has gone on to do.

Elsewhere[2], I have elaborated the thesis that Florisbad man is of lower rank than Rhodesian man,

and that he is an African variant of the Neanderthal race of Europe. This view is supported by the fact that as regards his cranium and brain-cast he is morphologically identical to the type Neanderthals of Europe. On the other hand, I admit that his face, although more massive and prognathous than in any of the Neanderthals, has a deep 'sapient' dip in it beneath the cheek bones. We must not let ourselves be carried away, however, by the idea that there was only the one European race of Neanderthals. His characteristic Moustierian culture, which has as close an association with this physical type as any known culture has with human form, is very widespread over the world, and I myself have picked up several Moustierian points on the veld, bearing all the hall-marks of the very special technique employed in making these stone implements. It is therefore a really very significant argument in favour of my view, when I state that the stone implements found associated with the skull in the 'Florisbad zone' present a typical Moustierian facies[3]. Seeing that we have no objection to accepting the Neanderthaloid Australian Bushman as one of the races of *Homo sapiens*, there can be no valid reason for rejecting a slightly sapient South African Neanderthal as a member of this latter species, provided it can be shown that the major facts of his anatomy point that way.

In any discussion of human morphology, the question arises as to what characters are to have most stress laid on them and as to what is to be our final criterion of advancement or retardation in the human scale. We have to decide whether it is to be the cranium with the underlying brain or the teeth and jaws, which go to make the face, that we are to rely most upon. There are enough data now to show that anthropologists cannot have it both ways. The Piltdown discovery put an end to the face as a criterion, for no one regards this type as anything but a man, in spite of his chimpanzee-like jaw and teeth. The same applies to the latest discovery of the adult *Australopithecus*[4]. Notwithstanding his human type of dentition, more human in some

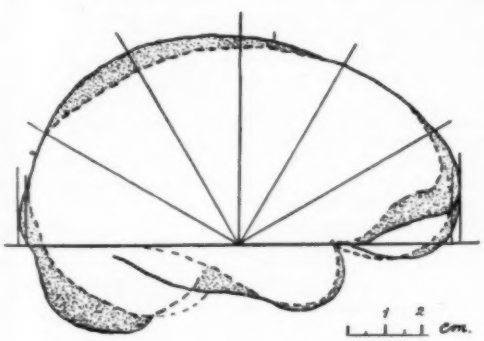

Fig. 1.

CONTOUR OF THE TAUNGS ENDOCAST SUPERIMPOSED ON THAT OF A CHIMPANZEE OF THE SAME AGE. THE STIPPLED AREAS INDICATE THE EXTENT TO WHICH THE FORMER EXCEEDS THE LATTER IN SIZE.

respects than that of both Piltdown and Peking man, Broom sums him up as "a chimpanzee with human teeth". In doing so, Broom is tacitly laying stress on the brain of *Australopithecus*, which he seems still to assume to be that of a chimpanzee, as so many other distinguished anthropologists have already done. For my part I do not consider the brain of the Taungs infant to be that of a chimpanzee. In a recent comparison which I have made between the brain cast of this fossil and the brain and brain cast of a chimpanzee of the same age, I have been impressed by the great difference between them. In

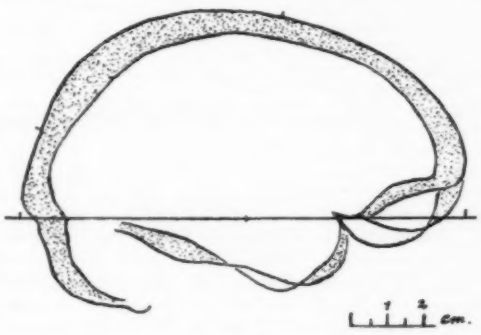

Fig. 2.

CONTOUR OF THE ENDOCAST OF *Australopithecus africanus* SUPERIMPOSED ON ONE OF A CHIMPANZEE WITH A CRANIAL CAPACITY OF 335 C.C. THIS CHIMPANZEE WAS A YEAR OLDER THAN THE TAUNGS INFANT, YET ITS BRAIN WAS INFERIOR TO THE EXTENT INDICATED BY THE STIPPLED AREA.

Fig. 1, I show how the linear contour of the cerebrum and cerebellum of the Taungs infant outstrips that of this chimpanzee. The surface of the brain cast of the former shows an equally striking superiority in the size and salience of its convolutions over that of the latter. The comparison I have drawn is not an isolated one, and in Fig. 2, I demonstrate how much more advanced the brain of the Taungs infant is beyond that of a slightly older chimpanzee, which it exceeds in bulk by 50 per cent. I have made other comparisons which show that the brain of the infant *Australopithecus* outclasses that of a gorilla of the same age, and that the mental endowment of this tiny creature can quite hold its own with even that of a huge adult gorilla.

The most noticeable advance in the brain of *Australopithecus africanus* is in the region behind the bregma (vertex), in the same place as all the main subsequent human advances have been made. His superiority over the chimpanzee in the cerebellar region is also very striking. With such knowledge of cerebral localization as we already have, it is fairly safe to interpret this parietal enlargement of the association area, located behind the sensory and motor areas for the leg, and this cerebellar hypertrophy, as being expressive of the human divorcement of the legs from the hands. From now on, the limbs had separate functions to perform and new machinery for their independent co-ordination. Arboreal habits were good enough to make a four-handed primate out of something else, but it took the open veld to make the first human toddler, now properly on his legs and free to use his hands for better handiwork—and occasional mischief. Even if we discount his human dentition entirely, which it would be rash to do, this surely is an upward step.

It seems to me, therefore, that many pronouncements regarding this unique South African fossil will have to be revised, and in fact that we cannot do better than go back to Dart's first classical description of it as published in NATURE of February 7, 1925.

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June 22.

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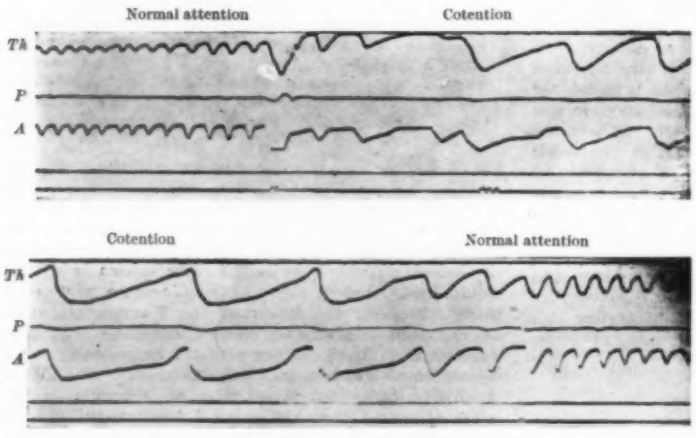
Kymograph Studies of Physiological (Respiratory) Concomitants in Two Types of Attentional Adaptation

THE group or phylobiological researches which I have carried out in the field of behaviour-disorders indicate that the neuroses and psychoses are aggravations of discrepant processes existing within society generally. In connexion with investigations of adaptive reactions, I have differentiated two internal attentional patterns[1]: (1) The pattern concomitant to ordinary *attention* in which the individual focuses upon external objects or upon images or symbols relating to them; (2) a pattern which I have distinguished as *cotention*, in which the individual focuses upon tensions located predominantly in the region of the eyes or in the segment of the symbolic activity.

The second pattern precludes the usual play of phantasies and the customary affects and strivings commonly adhering to mental imagery. Instead there is sensed the organism's generalized tensions as contrasted with the more specifically localized tensions of the symbolic segment. The competitiveness and self-concern characteristic alike of so-called normal and neurotic attitudes are eliminated, and there occurs a re-centring of interest which gives precedence to internally motivated, phyletically co-ordinated trends. Physiological (neuromuscular) modifications related to the organism's phantasy sphere have thus been differentiated from physiological modifications concomitant to the organism's direct relation to environmental reality.

Recent instrumental experimentation shows that the pattern of cotention is characterized by a scarcity of eye- and lid-movements and by specific changes of respiration, namely, (*a*) a markedly decreased frequency, (*b*) an increased amplitude of the respiratory movements, and (*c*) in certain subjects a decreased inspiration-expiration ratio. The respiratory curve, as obtained by thoracic and abdominal pneumographs, was recorded by the wax paper kymograph devised by Volkmann and Gerbrands (Harvard). The diminution in frequency was from a normal average of 12·8 to an average of 4·2 respirations per minute during cotention.

It was possible to differentiate these respiratory alterations sharply from other slight modifications occurring under varying conditions of mental rest or activity. The respiratory changes may be considered as part manifestations of the two types of attentional adaptation. They set in immediately with the altered attention; they occur automatically; and they are not affected by opening or closing the eyes.



KYMOGRAPH RECORDS WITH EYES OPEN (ABOVE), WITH EYES SHUT (BELOW). *Th*: THORACIC RESPIRATION; *P*, CAROTID PULSE; *A*, ABDOMINAL RESPIRATION. INSPIRATION IS RECORDED ON THE DOWN-STROKE, EXPIRATION ON THE UP-STROKE.

The differentiation of the two forms of attention is of special interest in relation to the problem of behaviour-disorders. Under conditions of cotention, symbolic projections possessing the emotionally coloured content characteristic of neurotic reactions are automatically arrested. The cotentive reaction may be brought about by training. Experimentation with respiratory changes is being continued in the laboratory of the Lifwynn Foundation, and other physiological patterns which underlie the two types of attentional adaptation are being investigated.

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April 18.

[1] Reported in my book, "The Biology of Human Conflict—An Anatomy of Behavior, Individual and Social" (New York: The Macmillan Company, 1937) (see NATURE, March 12, 1938, p. 462).

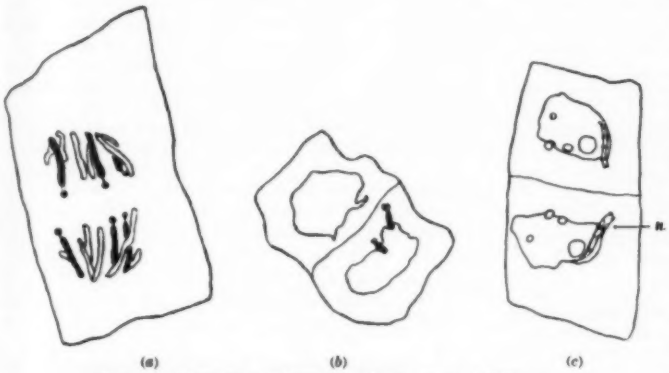
Chromosome Structure

IT was recently shown[1] that the somatic chromosomes of *Trillium* are composed of four strands intertwined in pairs at metaphase, while in anaphase and telophase they contain two spirally twined threads.

Recent cytological investigations of *Crocus sativus* (saffron) yield further crucial evidence regarding chromosome structure. This cultivated form is

triploid, having 24 somatic chromosomes. From preparations of root-tips, three of these chromosomes are seen in anaphase (Fig. 1*a*) to have a satellite attached to their long arm. As this material was fixed in Navashin, the split in the chromosomes does not show at this stage, and the satellites also appear as single structures. These satellites, as well as the chromosome, are, however, clearly seen in early telophase (Fig. 1*b*) to be double.

By a special staining method recently devised[2], it has been possible to stain the chromosomes and the nucleolus differentially, so that the nucleolus can be picked out at its very beginning in telophase, in contrast with the chromatin, and the thread attaching the satellite to the chromosome can be shown to be composed of chromatin. By a special method of mordanting, the chromosomes are stained red with Feulgen and the nucleolus light green. This staining method has also been applied to root-tip smears[3], making possible an investigation of the precise relationships between nucleolus, satellite, connecting thread and chromosome in various plant genera during both the somatic and the meiotic divisions.



(*a*) (*b*) (*c*)

Fig. 1. Mitosis in *Crocus sativus*. × *c.* 1,600.

(*a*) Anaphase. (*b*) Telophase showing split chromosomes. (*c*) Late telophase showing origin of nucleolus on split chromosome.

In *Crocus sativus* the three long satellited chromosomes generally project like fingers from the nuclei in telophase (Fig. 1*c*). In favourable positions, by the staining methods described above, the projecting arm of the chromosome can be clearly seen to be composed of two chromatids lying side by side, each with a terminal satellite. Moreover, by the new method of staining, at the base of each thread which connects the satellite to the (red) split chromosome can be seen a minute green granule, which represents the beginning of the nucleolus. Each nucleolus thus arises as two bodies close together, one on each of the twin threads of a telophase chromosome, showing conclusively the double structure of the chromosome at this time. As these nucleolar rudiments grow, they shortly fuse into one globular body, which then grows to the full-sized nucleolus of the resting nucleus.

It may be pointed out that Dearing[4] has shown essentially the same thing in the salamander *Amblystoma*, the telophase chromosomes being double and the nucleolus arising from the satellited chromosome as two granules, one on each chromatid. The present method of staining, by which the nucleolar material is green while the chromatin is red, makes it impossible to mistake the beginnings of the nucleolus for chromomeres.

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[2] Semmens, C. S., and Bhaduri, P. N., "A New Method for Differential Staining of the Nucleolus", *Stain Tech.* (in the Press).
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[4] *J. Morph.*, **56**, 157–179 (1934).

Distribution of Crossing-Over in the Chromosomes of *Drosophila*

From an analysis of crossing-over in *Drosophila melanogaster*, I was led to certain conclusions concerning the distribution of the chiasmata, or points of exchange, along the cytological chromosomes[1]. In particular I noted that the centromere, or spindle attachment, showed certain peculiar relations to the regional frequency of crossing-over, and I advanced the hypothesis of a time sequence in the occurrence of chiasmata (moving away from the centromere) to account for these observations.

This has recently been challenged by Charles[2] in an analysis of crossing-over in the *X*-chromosome of *Drosophila*. He finds that crossing-over has certain similar relations with the attachment end and with the free end of this chromosome. He concludes that the observed phenomena could be explained as well, or better, by relating the frequency of crossing-over to both ends jointly. Such a relation, he says, would account for all the evidence that I have adduced for the special relation to the spindle attachment. He also proposes certain alternative hypotheses, which, however, will not be considered here as they are not formulated with a precision sufficient to allow of prediction.

In considering Charles's claim that both ends of the chromosome play a part in the determination of crossing-over, we must distinguish between two possibilities, namely, that they play equal, or nearly equal parts, and that they both behave in a manner unlike the rest of the chromosomes but that their roles are not the same. The former would appear to be the alternative advocated by Charles. This, however, cannot be true, as it allows of no explanation of the special properties of the attachment region in the effects of age, temperature and similar agencies on variations in crossing-over. Nor does it allow of an explanation of the findings of Sturtevant and Beadle[3] with regard to the effect on crossing-over in the *X*-chromosome of heterozygosity for the Delta-49 inversion. These authors observed that in such a system crossing-over is considerably more affected, in the regions of normal sequence, distal to the inversion than in similar regions proximal to the inversion. Finally Charles's own figures, notably his Fig. 1, show asymmetry of the crossing-over frequency distribution along the salivary chromosome, though

this type of map (as compared with the mitotic map, which I consider to be more suitable for such studies) would tend to minimize such asymmetry. Similar skewness is to be observed from a number of other sets of data published by various authors. Thus we may exclude the possibility that the attached and free ends have precisely similar properties in crossing-over.

In considering the alternative, that both ends of the chromosome have properties unlike those of the central regions, but that the two ends do not behave alike, we are in effect discussing my original conclusion. A terminal region may be expected *a priori* to behave differently from the central regions if only because it is an end. But the different behaviour of the two ends is not to be anticipated in such a way, and inasmuch as the attachment end differs very markedly from all other regions, we must endeavour to account for its behaviour by giving it a special role in the process of crossing-over. This I attempted to do by the hypothesis of the time sequence in chiasma formation. The virtues or shortcomings of this hypothesis as an explanation of the observed unique behaviour of the attachment region cannot be considered here, but new data, bearing on the question, will be discussed elsewhere in detail.

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[1] Mather, K., *J. Genet.*, **33**, 207–35 (1936).
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Control of a Species-Difference by Means of a Difference in an Inductor

HITHERTO, experimental analyses of species differences by the use of xenoplastic transplantations have shown that the distinguishing characteristics are inherent in the tissues themselves. This is especially true when one considers organs which owe their differentiation to induction from other parts. The inductor of one species, although able to produce an effect on tissues of another species, acts only as a release mechanism calling forth certain potencies without impressing the characteristics of its own species on the reacting system.

Xenoplastic transplantations between two species of *Drosophila* have yielded a different result. The adult testes of *D. pseudoobscura* are approximately ellipsoids, while those of *D. azteca* are tubes wound up in form of a spiral of about one and a half turns. Larval testes of both species are very short ellipsoids. They attain adult shape after having become attached to the vasa efferentia, which originate independently of them. Dobzhansky[1], in an analysis of gynandromorphs in *D. simulans*, has pointed out that the spiral form of the testes in this species is probably due to some 'organizing' influence exerted by the vas, as the testes, in spite of increase in volume, remain ellipsoidal if not attached to a duct. This has been confirmed by numerous transplantation experiments involving five other species[2].

In order to test whether this 'induction' of adult form is of the nature of a release mechanism, to which the gonads respond according to their genetic constitution, reciprocal transplantations of larval gonads between *D. pseudoobscura* and *D. azteca* were made. The shape of the implants was studied after the metamorphosis of the operated animals into adults. It was found that the 'genetically spiral' testes of *D. azteca* assume an elongated ellipsoidal form if attached to a vas of *D. pseudoobscura* and that the 'genetically ellipsoidal' testes of *D. pseudoobscura* grow into a spiral if attached to a vas of *D. azteca*. Here, then, we are confronted with a case in which the structure of an organ of one species has been determined by a specific organizing influence exerted by tissue of another species. The fundamental difference in testis shape between *D. pseudoobscura* and *D. azteca* is not a result of the genetic differences of these organs, but depends rather upon a difference in the constitution of the inductor, the vas efferens.

The contrast between this and former results with xenoplastic induction loses some of its sharpness if we consider the probable nature of the organizing action on the shape of the testes. Here we are not dealing with the induction of tissue differentiation, since the testis is already histologically differentiated, but with the distribution of growth processes. A testis probably assumes a spiral form as the result of unequal growth in the length on two opposite sides of its surrounding membrane, while an ellipsoidal testis has undergone growth of equal intensity for all regions at any given level of its periphery. It is suggested, therefore, as a working hypothesis that the control of testis shape in these *Drosophila* species is the result of some growth-influencing principle unequally distributed over the proximal parts of the vasa of *D. azteca* as contrasted with a symmetrical distribution of such a principle in *D. pseudoobscura*.

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[2] Stern, C., and Hadorn, E., *Amer. Natur.*, **72**, 42–52 (1938); also unpublished data.

Neutral Particles in Cosmic Radiation

A NUMBER of cosmic ray experiments seem to indicate the existence of a non-ionizing penetrating radiation which is capable of producing charged secondaries and showers. Barnóthy and Forró[1] have found that at a depth of 800 m. water-equivalent, practically the whole ionization is due to shower particles and not to single ionizing rays. From this fact they concluded that the shower producing radiation must be non-ionizing, and owing to its high penetrating power they proposed to identify it with neutrinos.

In a more conclusive way the existence of a neutral penetrating radiation is shown by the experiments of Maass[2]. He measured the absorption of single cosmic ray particles by a counter telescope placing an iron block of varying thickness (A) between the counters and (B) above the top counter. The difference of the number of coincidences $(B) - (A)$ must obviously be due to ionizing secondaries produced in the iron by a non-ionizing radiation[3]. The curve $(B)-(A)$ has a maximum at a thickness of 30 cm. iron. For higher thicknesses the curve decreases very slowly corresponding to an absorption of the primary neutral radiation. The absorption coefficient ($\sim 9 \times 10^{-3}$ cm.$^{-1}$ iron) is practically the same as that of the charged penetrating component, which is now known to consist of heavy electrons. The absorption coefficient of the charged secondary

particles ($\sim 8 \times 10^{-2}$ cm.$^{-1}$ iron) is, though about ten times larger than that of the primary neutral radiation, still far smaller than that of ordinary electrons. We therefore assume that the secondary particles are relatively slow heavy electrons.

The fact that the absorption of the primaries is very similar to that of the heavy electrons suggests that they are of a similar nature. Indeed it seems to be impossible to identify them with any other known neutral radiation. Neutrons would have a much smaller penetrating power and there is no process known by which neutrinos could produce heavy electrons in sufficient large numbers. We therefore think that we have to deal in these experiments with *the neutral counterpart of the heavy electron*, for which we propose the name *neutretto*.

The existence of such a particle has indeed been made very probable by recent theories of the nuclear forces[4]. In these theories the heavy electron is made responsible for the exchange forces between a proton and a neutron. The fact that the forces between two protons seem to be equal to those between a proton and a neutron requires the existence of a neutral particle which has the same mass and similar other properties as the heavy electron. It has also been shown by Kemmer[5] that, assuming equality of all the nuclear forces, the neutral particle can be included in the theory in a very simple and natural way. According to this theory, the behaviour of a neutretto would be very similar to that of a heavy electron. Apart from those processes in which the charge is involved directly (ionization, emission of light) the neutretto would give rise to all the same types of showers which heavy electrons can produce, as discussed in a recent paper by one of us (W. H.)[6].

In particular a neutretto (denoted by Y^0) can be transformed into a heavy electron, $Y^{\pm}$, during a collision with a proton (P) or neutron (N) and vice versa:

$$Y^0 + N \rightleftarrows P + Y^- \text{ or } Y^0 + P \rightleftarrows N + Y^+ \quad (1)$$

For an energy of the order 10^8 e.v. the theory leads to a cross-section which would allow a neutretto or a heavy electron to travel a distance of the order 5 cm. lead, 7 cm. iron or half a metre water before such a transformation takes place[5]. For higher energies, however, the processes (1) are replaced by the production of showers consisting of heavy electrons created in a single multiple process; for example,

$$Y^0 + P \rightarrow N + Y^+ + Y^- + Y^+, \text{ etc.} \quad (2)$$

The mean kinetic energy of the particles created in such a process is of the order of a few times the rest energy ($mc^2 \sim 10^8$ e.v.). For a given energy of the primary particle the mean number of shower particles is therefore also determined. The cross-section for the occurrence of such a process cannot, however, be deduced from the theory, but the experiments show that it decreases with increasing energy, thus leading to a high penetrating power of the heavy electron and neutretto.

The experiments discussed above are quite consistent with these ideas. In particular, the curve obtained by Maass can easily be understood by the production of heavy electrons by neutrettos according to (1) and (2). The energy and penetrating power of the secondary heavy electrons to be expected in this theory (~ 7 cm. iron) are just of the order obtained experimentally (~ 12 cm. iron).

We think it likely that the neutretto is responsible for the majority of processes ascribed to neutral penetrating particles in cosmic radiation, although, of course, the participation of neutrons or neutrinos cannot be excluded.

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June 15.

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[3] Prof. Blackett has kindly pointed out to us that a certain part of this difference may be due to scattering. This question can only be settled by further experiments.
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Viscosity of Air and the Electronic Charge

I SHOULD like to be allowed to make two comments on the recent communication in NATURE of Dr. G. B. Banerjea and B. Pattanaik[1]—a letter giving the preliminary results of what is evidently a very accurate determination of the viscosity of air.

First: the generally accepted X-ray value of the electronic charge is $4{\cdot}803 \times 10^{-10}$ E.S.U.—not $4{\cdot}807 \times 10^{-10}$. Secondly: there are now available the results of three independent and extended series of measurements on oil-drops, namely, (1) the pioneer work of Millikan, (2) the more recent work of Bäcklin and Flemberg[2], and (3) the very recent work of Ishida, Fukushima and Suetsugu[3].

It is of considerable interest to combine the results of these three measurements with the value of the viscosity of air obtained by Harrington[4] in 1916 (the value used by Millikan) and with the more recent values of other workers, and to calculate the resulting values of e.

The values of the viscosity are (all in 10^{-7} poise, and reduced to 23° C.):

(*a*)	1822·6	(*d*)	1833·3
(*b*)	1834·8	(*e*)	1830·3
(*c*)	1829·2		

(*a*) is Harrington's value[4], (*b*) is the mean of two almost identical values obtained independently by Bond[5] and Kellström[6], (*c*) is due to Houston[7], (*d*) to Banerjea and Pattanaik[1] and (*e*) to Rigden[8]. The results of the calculations are tabulated below, e being given in 10^{-10} E.S.U.:

Oil-drop → / ↓ Viscosity	(1) Millikan	(2) B. and F.	(3) I., F. and S.
(*a*)	*4·770*	4·752	*4·806*
(*b*)	4·818	*4·800*	4·854
(*c*)	4·796	4·778	4·832
(*d*)	4·812	4·794	4·848
(*e*)	4·800	4·782	4·836
Means ..	4·799	4·781	4·835

Mean of all sets together: 4·805.
(The italic values of e are those given by the authors.)

Possibly the only justifiable conclusion to be drawn from all this is that the oil-drop method (because of the many difficulties and uncertainties in its application) is not suitable for the exact determination of e. It is of interest, however, to note that of the three available sets of oil-drop measurements, Millikan's work now appears to be in by far the best

agreement with the X-ray results. In fact if we leave out Harrington's value for the viscosity (which seems certainly to be too low), and use the mean of the remaining values, Millikan's measurements give $e = 4{\cdot}806 \times 10^{-10}$ E.S.U. If we also omit Bond's and Kellström's values, which seem likely to be too high—that is, if we only use the most recent three measurements of the viscosity—Millikan's value becomes $4{\cdot}803 \times 10^{-10}$—in exact agreement with the X-ray measurements.

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Waves Associated with Moving Corpuscles

By appropriate general treatment, it may be shown that solutions involving the path time are invariant, that is, can exist in any set of space co-ordinates. Starting, then, with the solution for the electron velocity ripple in terms of the transit half-angle[1], it may be shown, by analogy with van der Pol's treatment of waves in n dimensions[2], that this ripple satisfies certain conditions. The most important of these is that the ripple satisfies a five-dimensional wave equation, the wave velocity being that of the particle, provided the frequency of the ripple is such that $\theta \geqslant \sqrt{2}$, where θ is the transit half angle ($= \omega\tau/2$). It will be convenient to regard this ripple as that part of the particle vibration which corresponds to free, as distinct from forced, oscillation. The factor $\frac{1}{2}$ must be associated with the fifth dimension, as follows:

$$\theta = \omega\tau/2 = \omega(t-t_1)/2 = \omega r_5/c_5$$

where c_5 is the velocity appropriate to the waves.

I have confirmed that, when no 'weight factor' is involved, the result of integrating transit time solutions over all possible values of θ (that is, from $\theta = 0$ to $\theta = \infty$) leaves the four-dimensional solution that would have been obtained had the transit time been taken as negligible. Thus (i_e = electron convection current, $\bar{\imath}$ = total current density (ripples).

$$[i_e]_4 = \bar{\imath}e^{i\omega t}\int_{\theta=0}^{\theta=\infty} \Upsilon_3(2i\theta)\, di\theta = \bar{\imath}e^{i\omega t}\left|\frac{e^{-2i\theta}-1}{2i\theta}\right|_0^\infty = \bar{\imath}e^{i\omega t}$$

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[1] Benham, W. E., *Phil Mag.*, **5**, 648 (March 1928).
[2] van der Pol, B., *Physica*, **3**, 385–392 (June 1936).

A Useful Statistical Test

THE method described below gives a useful criterion of the significance of the difference between an observed and a hypothetical frequency distribution. Since it provides an exact test, it is particularly useful in the case of small samples, in which the expectation in some frequency classes may be very small. It is only applicable when the number of possible samples containing the same number of observations as the observed sample is determinable. The test answers the question: Is this a reasonably likely sample to be obtained in a random draw? It does not give the proportion of less likely samples which may be expected to arise, as does the χ^2-test.

Let us suppose that the hypothetical population shows the following proportional frequencies in four classes:

$$\tfrac{1}{8},\ \tfrac{3}{8},\ \tfrac{3}{8},\ \tfrac{1}{8},$$

the total being 8.

The number (N) of possible samples of n with r frequency classes is given by

$${}_rH_n \text{ or } \frac{(r+n-1)!}{(r-1)!\ \ n!}$$

Thus the number of possible samples of 8 in 4 classes is

$$\frac{11!}{3!\ 8!}, \text{ or } 165$$

Clearly the average probability of the samples is $1/N$ or $1/165$. An observed sample having average probability cannot, of course, be considered as an unlikely sample to arise. Half the average probability has been found to separate samples at about the 5 per cent point, agreeing closely with χ^2 ($p = 0{\cdot}05$) in cases where both tests are applicable. It is only necessary, therefore, to express p, the probability of an observed sample, as a fraction of $1/N$, considering the sample as unlikely to have arisen from the hypothetical population if Np is less than $0{\cdot}5$.

For example, is a sample of eight having the frequencies 3, 1, 1, 3, likely to have arisen as a random sample from the population specified above? $N = 165$, and p is given as a term in the multinomial distribution. Thus,

$$Np = 165 \times \frac{8!}{3!\ 1!\ 1!\ 3!}\ \ (\tfrac{1}{8})^3(\tfrac{3}{8})^1(\tfrac{3}{8})^1(\tfrac{1}{8})^3 = <0{\cdot}1$$

The sample is, therefore, very unlikely to have arisen as a random sample from the hypothetical population.

The change in the number of possible samples with a change in r corresponds to a change in the number of degrees of freedom with the χ^2-test. Other restrictions on variation, such as the use of a calculated mean or standard deviation, do not change the number of possible samples at all in the same way. This suggests that restriction in the χ^2-distribution is much more accurately allowed for by degrees of freedom in the case of differences in the numbers of frequency classes, than it is with restrictions imposed by the use of calculated statistics in specification of hypothetical populations.

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June 22.

Passivity of Iron to Natural Waters

THE passivity of iron has been known for more than a century, but until recently interest has mainly been directed to treatments which render iron inert to copper salts; such treatments do not necessarily prevent rusting by natural waters. Three sets of observations in this laboratory have indicated how passivity to such waters might be obtained. (1) The film present on iron rendered 'passive' in chromate appears to be the air-formed film with its weakest places fortified with chromium oxide[1]; a 'patchwork' is not ideal for protection. (2) The coarser the grinding of an iron surface, the longer the time needed to produce passivity[2]. (3) Susceptibility to corrosion, as judged by statistical studies, varies from spot to spot and is influenced by chemical character[3].

These facts have suggested (*a*) preliminary abrasion, followed by (*b*) the etching away of the 'shattered' metal which is difficult to render passive, and finally (*c*) treatment in a solution containing chlorides and chromates in amounts adjusted to eat away specially susceptible spots whilst leaving the remainder passive. (On pure iron, where there are no chemically different spots, chloride-free chromate gives almost equally good results.)

After such treatment, specimens of iron or mild steel, 1·8 cm. square, have been preserved in various natural waters, and have only produced a rusty colour in the water after periods of the order of 100 times those required with untreated metal. Thus soft moorland water, which becomes rusty after about an hour's contact with untreated metal, remains clear for several days if the metal has first been treated; harder waters from chalk sources, which acquire a rusty tint within a day from untreated metal, have remained unchanged for some months in contact with treated metal. But the 'expectation' of escaping corrosion decreases with the specimen-size, and, although encouraging, the observations are not thought to possess immediate technical importance, especially as the treatment does not prevent rusting by a polluted atmosphere.

The behaviour of the passive iron to scratching is very interesting. Iron covered with a *visible* oxide scale by heating and scratched locally before immersion often suffers intensified corrosion, since the oxide-scale acts as cathode of a cell which concentrates anodic attack on the small area of exposed metal; but a specimen of iron, rendered passive and then engraved with a scratch in the Mears-Ward machine[4] (66 tons/sq. in.), has remained in Cambridge water for three months without appreciable change (similar iron not rendered passive produces rust within a day). A possible explanation—suggested by studying films transferred to celluloid, as described elsewhere[5]—is that, whilst the engraving of a scratch line causes a *thick* film to crack off, exposing the iron, it tends to press a *very thin* film down into the groove, so that the metal remains largely covered. Some interruption of the film is certainly unavoidable, but this will not necessarily cause corrosion if the interruptions are very small, since the anodic current density may then reach the value needed to restore passivity; the largest gap which can be tolerated will depend on the composition of the water.

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June 23.

[1] Hoar, T. P., and Evans, U. R., *J. Chem. Soc.*, 2476 (1932).
[2] Evans, U. R., *J. Chem. Soc.*, 1030 (1927).
[3] Mears, R. B., Carnegie Scholarship Memoirs, **24**, 69 (1935). Compare C. E. Homer, Iron and Steel Inst. Corr. Comm. 2nd Report, 225 (1934).
[4] Mears, R. B., and Ward, E. D., *J. Soc. Chem. Ind.*, **53**, 382T (1934).
[5] Evans, U. R., Iron and Steel Inst. Corr. Comm. 5th Report, 225 (1938).

Negative Thixotropy

Aqueous solutions of ammonium oleate are strongly elastic. If given a rotary motion and then allowed to come to rest, the rotation is in part retraced before they do so. In 1926, Hatschek and Jane[1] examined these solutions in a Couette-type viscometer. They found, *inter alia*, that when the outer cylinder was rotated at a constant angular velocity, the torque on the inner one, after a short period of normal magnitude, increased to an irregularly fluctuating value many times greater. After a period of rest, the behaviour was repeated. It appeared that a gelatinous structure was actually built up by the process of shear, and dissipated again at rest. The subsequent discovery[2] that the anomalous increase of torque was associated with the onset of turbulence distracted attention[3] from this first conclusion. It seems probable, however, that the turbulence itself, also anomalous and of abnormal appearance[3], was another result of the structure built up rather than the direct cause of the increased torque.

Solutions of many of the newer paraffin chain salts also show the phenomenon of elastic recoil, and in more pronounced degree, and similar behaviour in the Couette viscometer. The observations now referred to were made mostly on a 0·02 per cent solution of the copper salt of cetyl-phenyl-ether sulphonic acid at 80–90° C.

A very simple experiment demonstrates what may be called the 'negatively thixotropic' behaviour. A slow stream of air bubbles of suitable size is introduced at the bottom of a large beaker full of solution. They rise in normal manner and in normal time (for water) if the solution is undisturbed. If the solution is now gently stirred round, their upward course takes many times as long and is extremely irregular. The bubbles frequently collect in small clusters and, whether single or in clusters, they are seen to halt at, or be diverted round, invisible barriers. About a minute after the stirring is stopped, the normal behaviour is almost completely restored.

Further evidence is found in experiments on flow through plugs of fibrous material, for example, glass wool, cotton wool or (at 60°) wool felt. If a pressure difference is applied suddenly, after a period of complete rest, the flow is at first about as rapid as with water, but quickly falls to a steady value only a small fraction of that obtaining initially. Pressure differences in excess of a somewhat critical value cause permanent rapid flow. The smaller the applied pressure difference the smaller is the volume passed before the limiting slow flow is reached, and, after attainment of this limiting flow in one direction, immediate reversal of the pressure difference (keeping its magnitude the same) simply reverses the flow at the limiting value, the initial rapid stage being eliminated.

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Sir William Ramsay and Ralph Forster
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[1] Hatschek, E., and Jane, R. S., *Koll. Z.*, **38**, 33 (1926).
[2] Andrade, E. N. da C., and Lewis, J. W., *Koll. Z.*, **38**, 260 (1926).
[3] Hatschek, E., *Koll. Z.*, **38**, 259 (1926).

Crystal Structure of Succinic Acid

The cell dimensions of the low-temperature form of succinic acid have been found to be $a = 5{\cdot}10$, $b = 8{\cdot}88$, $c = 7{\cdot}61$ A., $\beta = 133°\ 37'$, in agreement with those found by Yardley[1]—with other choice of *c*-axis—and Dupré la Tour[2]. The space group is $C_{2h}^5 - P2_1/a$. The cell contains two molecules; as the general atomic position of the space group $P2_1/a$ is 4, this leads to the conclusion that the molecule has a centre of symmetry.

The crystal shows pronounced fibre cleavage along the *c*-axis, this being also the direction of the largest refraction index. These facts indicate that the

molecule lies along the *c*-axis, the length of which, 7·61 A., is in accordance with this assumption. To find the azimuth round this axis, a Patterson analysis of the [001]-projection was made; this shows a relatively narrow ridge going through the origin and making an angle of about 37° with the *b*-axis. This ridge will correspond to inter-atomic distances in the molecule, which is accordingly approximately flat, lying in a plane through the *c*-axis and intersecting the *a*-*b*-plane along the direction shown by the ridge. A second hump of greater dimensions in the middle of the projection can be interpreted as caused by the inter-molecular distances. As the details of the Patterson analysis were not very clear, owing to many distances overlapping, it was not possible to derive further information from it.

Several models were found to be possible on geometric grounds. Only one of these models gave reasonable agreement with the intensities of the reflections *hkO*, *hOl* and *Okl*. On the basis of this model, Fourier analyses of the projections [100] and [010] were made. The resulting parameters are:

	x	*y*	*z*
C_1	0·021	0·036	0·258
C_2	0·056	0·067	0·081
O_1	−0·133	−0·080	0·253
O_2	0·167	0·142	0·422

The distances between the C-atoms were found to be 1·52 and 1·51 A., in accordance with the standard distance 1·54 A. for the single aliphatic bond. In this respect, succinic acid differs strikingly from oxalic acid, where the C-C bond is found to be considerably shortened by the influence of the carboxyl group[3]. The C-C bonds include an angle of about 110°.

The calculated C-O distances are 1·28 and 1·31 A.; O-O in the same molecule is 2·28 A.; the distance between oxygen atoms of different molecules is 2·65 A.

The details of the structure and of its determination will be published elsewhere.

(The late) H. J. VERWEEL.
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June 25.

[1] Yardley, K., *Proc. Roy. Soc.*, A, **105**, 451 (1924).
[2] la Tour, Dupré, F., *C.R. Acad. Sci. Paris*, **193**, 180 (1931).
[3] Robertson, J. M., and Woodward, I., *J. Chem. Soc.*, 1817 (1936).

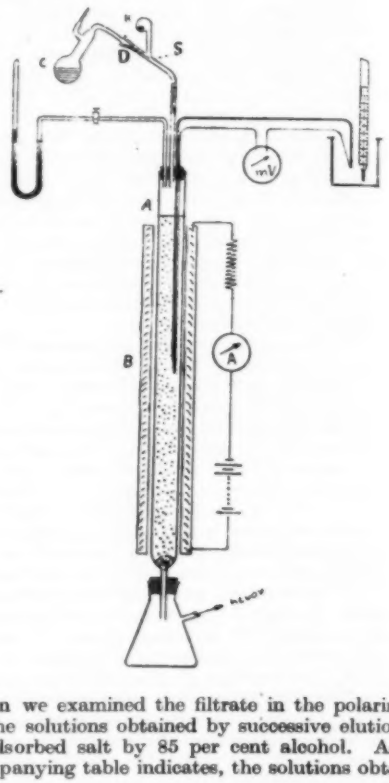
A New Method of Resolving a Racemic Compound

WE have recently developed a new method of resolving a racemic compound by selective adsorption, and the results we have obtained, already published in the *Praktika* of the Academy of Athens (April 1938), agree in the main with similar experiments of G. M. Henderson and Dr. H. Gordon Rule[1].

The method is based upon the different degree of adsorption which an optically asymmetric crystal, as *d*- or *l*-quartz shows, for the two antipodes. The result of this selective adsorption is that when a *d*-*l* solution is passed through a Tswett column, its *d*- and *l*-components are separated and located at different heights.

We used quartz powder prepared from *d*- and *l*-quartz crystals as the asymmetric adsorbing medium and a solution of tri-ethylenediamine chromichloride ($(Cr\ en_3)\ Cl_3 + 3\frac{1}{2}\ H_2O$) as the racemic compound. We have chosen this compound because of its great molecular rotation power, which is 3,000° for 5890 *A*.

The apparatus employed is shown in the figure below. After activating the adsorbing medium by heating in vacuum, we let the racemic solution pass through the column *A* of the quartz powder by breaking the glass end *S* by the metal sphere *K* and tipping up the vessel *C*, thus avoiding contact with any grease.



Then we examined the filtrate in the polarimeter and the solutions obtained by successive elutions of the adsorbed salt by 85 per cent alcohol. As the accompanying table indicates, the solutions obtained

OPTICAL ACTIVITY OF SUCCESSIVE ELUTED SOLUTIONS

Adsorbing medium	I	II	III	IV	V
l-quartz	−0·023	−0·041	+0·020	+0·108	
l-quartz	−0·058	−0·121	−0·018	+0·046	+0·034
d-quartz	+0·023	−0·020	−0·050		

show optical activity. By using *d*-quartz the first elutions are dextro-rotatory and the next solutions are lævo-rotatory. By using *l*-quartz the opposite occurs. This indicates that the asymmetric quartz surface adsorbs more strongly the antipode of the opposite sign.

It is easily shown by a thermodynamic cycle that the selective adsorption of the antipodes by optically asymmetric surfaces can be reduced to a difference in the heat of formation of the adsorbed antipode molecule from adsorbed atoms on the asymmetrical quartz.

These experiments throw a new light on the problem of the genesis of the first substance with optical activity. It is possible that this substance

was formed by many successive adsorptions and elutions of a racemic compound on optically asymmetric surfaces of minerals.

Experiments are in progress with the object of extending the research to other substances; the details of which will be published elsewhere.

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NATURE, 141, 917 (May 21, 1938).

WE are greatly interested to read of the success obtained by Prof. Karagunis and G. Coumoulos in effecting a partial resolution of a complex chromium salt by the use of active quartz. Following up the work of Tsuchida, Kobayashi and Nakamura[1] upon the detection of a racemic inorganic complex by immersing powdered active quartz in its solution, we have also been examining the possibility of extending these results by the use of quartz columns in conjunction with inorganic as well as organic complexes.

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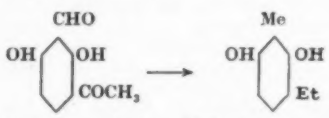
[1] *Chem. Soc. Japan*, **56**, 1339 (1935).

Modified Gattermann Reaction: Synthesis of Hydroxy-Formyl-Phenyl-Ketones

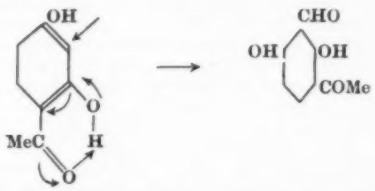
ONE of the authors (R. C. S.) with Laiwalla has previously shown that methyl β-resorsylate does not undergo the Gattermann reaction under the usual conditions, that is, in the presence of zinc chloride in ether or in the presence of aluminium chloride in benzene; the reaction takes place readily, however, in the presence of anhydrous aluminium chloride dissolved in dry ether, with the formation of the aldehyde ester, methyl 2 : 4 dihydroxy-3-formyl benzoate[1].

We now find that polyhydroxy-phenolic ketones also give aldehydes in high yields under the condition of Shah and Laiwalla's modified Gattermann reaction[1], the formyl group entering (when possible) the usually inaccessible *Y*-position in the resorcinol nucleus. Thus resacetophenone gives 2-4-dihydroxy-3-formyl acetophenone, the constitution of which is established by its reduction by the Clemmensen method to 4-ethyl-2-methyl resorcinol of Robinson and Shah[2].

Orsacetophenone, 2-acetyl resorcinol, 2-4-dihydroxy benzophenone and phloracetophenone afford similarly 2-4-dihydroxy-6-methyl-3-formyl-acetophenone, 2-6-dihydroxy-5-formyl-acetophenone, 2-4-dihydroxy-3-formyl-benzophenone and 2-4-6-trihydroxy-3-formyl-acetophenone respectively.



The orientation of the aldehydes from resacetophenone, orsacetophenone and 2-4-dihydroxy-benzophenone, in which the formyl group enters the 3-position instead of the usual 5-position, is of interest. These results are best explained on the view that the chelation between the hydroxyl and the acetyl group stabilizes the double bonds in the resorcinol nucleus; the carbon atom in the 3-position, which is united by a double bond to the carbon atom bearing the 4-hydroxyl group, is thus the point of attack (*cf.* W. Baker[3]).



The synthesis of such hydroxy-formyl-phenyl ketones opens up various possibilities for the synthesis of heterocyclic compounds containing oxygen in the ring-like coumarino-*Y*-pyrones, furo-chromones, etc., which are being explored.

A detailed account of the above investigation will shortly be submitted to the Chemical Society.

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[1] Shah and Laiwalla, *Current Science*, 197 (1936).
[2] Robinson and Shah, *J. Chem. Soc.*, 1494 (1934).
[3] Baker, W., *J. Chem. Soc.*, 1684 (1934).

Long-distance Radio Reception and the E-Region of the Ionosphere

MR. ALEXANDER A. MCKENZIE, of the Mount Washington Observatory, has reported a well-marked case of the long-distance reception of amateur 56–60 megacycle signals, which occurs occasionally at this time of year. A letter from him reads in part: "We started listening about 1930 E.S.T. (June 5, 1938) and listened continuously until about 2045. During the whole time, long-distance signals were fading in and out fairly rapidly with extremely audible volume at the start, for instance, of a call letter group and absolute silence before the group was completed."

Mr. McKenzie, on Mount Washington, heard twelve Middle Western stations, and reports a supplementary list of seven other stations which were being called by various amateur stations in the New England area. With two exceptions which may be ascribed to faulty identification, the stations heard in New England appear to have been closely grouped about a point somewhat south of Chicago. The minimum and maximum distances involved are 780 and 960 miles, the mean being 880 miles.

Continuous records of the heights of reflections from the ionosphere are made at Cruft Laboratory at a frequency of 3·5 megacycles. On the night in question, remarkably strong abnormal *E* region reflections were observed from 1912 to 2035 E.S.T., the number of multiple reflections varying from four to six. At 2035 the reflection began to decrease in intensity, and it disappeared completely at 2050. The apparent height of reflection was 120 ± 3 km. throughout the period.

We may identify the long-distance transmissions as being caused by extremely high ionization in the *E* region and, from the observed height and distance, deduce a minimum ionization density which must have obtained on this occasion. The angle of incidence of the transmitted rays upon the *E* layer was such that the critical frequency for normal incidence must have been slightly more than one-fourth of the transmission frequency, or about 15 megacycles. This corresponds to a density of free electrons of about $2{\cdot}8 \times 10^6$ per cm.^{3}, or their equivalent in heavy ions. Too little is known of the effective recombination coefficients at such heights to permit the calculation of the corresponding energy density. On the assumption, however, that the highest frequency normally reflected from the *E* region is about four megacycles, we may say that the ionization-producing energy on this occasion was about 200 times that due to ultra-violet light at noon on a summer day.

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June 13.

Enhancement of the Sodium *D* Lines in the Twilight Sky Light

Prof. J. Cabannes, Prof. J. Dufay and J. Gauzit[1] state that the twilight enhancement of the yellow radiation of the night sky announced by me[2] was previously observed by Currie and Edwards at Chesterfield (Canada) during the International Polar Year, 1932–33. To support their opinion, they give a short quotation from a paper published in 1936 by the Canadian physicists[3]. The complete sentence should have been quoted; it is as follows:

"The fairly uniform intensity of 5940 during moonlight, irrespective of the intensities of the green line and the negative bands, indicates that it is due to a luminescence distinct from that of the aurora and is probably the radiation 5893 A. observed by Vegard and Tonsberg in the night-sky light."

Thus the band around 5940 A. appeared to Currie and Edwards remarkably constant during the moonlight periods. It is only upon this observation that they based their suggestion. However, if it is quite certain that the band at 5940 does not belong to the auroral spectrum, it is no less certain, on account of its aspect and evolution, that it cannot be identified with the sky line 5893 A. Currie and Edwards also state: "It appeared to be a broad, diffuse band extending from about 6000 A. to 5800 A. with a mean wave-length of 5940 A." This broad and diffuse appearance (200 A.) cannot be that of an atomic line or narrow doublet. On the contrary, it can be explained very exactly by the spectral sensitivity of the plates (Ilford Soft Gradation), which offer a sharp and strong maximum exactly in this region, and by admitting that the so-called band near 5940 A. originates from the continuous spectrum of the moonlight. In fact, the intense yellow band obtained by Currie and Edwards remains absolutely invisible when the auroral spectrum is photographed, with full moon, on another type of plate (Agfa I.S.S.). Taking into account some supplementary arguments, developed in another paper[4], it seems beyond doubt that the yellow sky radiation 5893 A. was never observed by Currie and Edwards. It is thus clear that their work gave me no information or suggestion likely to guide me in the discovery of the yellow fluorescence or resonance of the twilight sky.

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[1] NATURE, **141**, 1054 (1938).
[2] NATURE, **141**, 788 (1938).
[3] *Terr. Mag.*, **41**, 265 (1936).
[4] *C.R.*, **206**, 1137 (1938).

Use of Non-Conservative Properties of Sea Water to Physical Oceanographical Problems*

IN applying the eddy diffusion equation to the non-conservative properties of sea water (as distinguished from the conservative properties, the concentrations of which change only as a result of physical processes) a knowledge of the time rates of change in their concentrations (as a result of the biological activity in the water mass) is required. Thus, the form of the equation expressing the effect of vertical turbulence alone on a non-conservative property, such as oxygen, would be:

$$\frac{d\alpha}{dt} = A\,\frac{\partial^2\alpha}{\partial t^2} - C,$$

where, for dissolved oxygen, α, the term C would represent the rate of oxygen consumption due to the biological activity in the water mass. The consumption of oxygen in the sea as a means of disguising the oxygen transport by turbulence is frequently strikingly brought out at the depths of the oxygen minimum concentration where, regardless of enrichment by eddy diffusion, oxygen concentration actually decreases in the downstream direction due to the greater rate of oxygen consumption.

Information on the rate of oxygen consumption in the depths of the ocean basins is confined chiefly to results obtained for the mid-Atlantic between latitudes 0° and 30° N., where the mean annual oxygen consumption at mid-depths was placed at approximately 0·42 c.c. per litre and that in the deeper water at approximately 0·10 c.c. per litre. Use has been made of the former value in calculating the magnitude of the vertical eddy coefficient at mid-depths (at depth of the minimum oxygen concentration) in the Caribbean basin; where, with certain assumptions, the gain and loss of oxygen in the downstream direction could be formulated, thus:

$$Ct = O_1 - O_2 + A\,\frac{\partial^2 O}{\partial t^2}\,t$$

where Ct represents the amount of oxygen consumed in the downstream direction by biological activity as the water layer (at the depth of the minimum oxygen concentration) moved, during the time, t, from position 1 to position 2; $A\,\frac{\partial^2 O}{\partial t^2}t$, the amount of dissolved oxygen gained as a result of vertical turbulence during the same time (effects due to lateral turbulence are neglected); and $O_1 - O_2$, the observed difference in oxygen concentration (at the depth of the minimum oxygen concentration) between positions 1 and 2. The combination of this equation with a similar one involving the conservative property (salinity) at adjacent depths gave two

* Contribution No. 181 from the Woods Hole Oceanographic Institution.

equations which were solved simultaneously for the values of A and t.

Substances dissolved in sea water the concentrations of which are altered by biological activity are useful in investigations of its circulation when used either as simple identifying properties or in combination with a conservative property; in such cases it is frequently not necessary to know the rate of the biochemical change of concentration. Particularly useful combinations of conservative and non-conservative properties, such as oxygen and salinity, or oxygen and temperature, may under certain defined conditions be used to trace movements and mixing of water masses and to supplement the results of circulation as calculated from the Bjerknes circulation theorem. The oxygen salinity or oxygen temperature relationship has its counterpart in the temperature salinity relationship (originated by Helland-Hansen), but differs in that the latter strictly conservative relationship is chiefly useful in interpreting combinations of water masses of distinctly different physical properties, whereas the combination of conservative and non-conservative properties may be used advantageously in investigating characteristics of a water mass of marked homogeneity. The latter relationship recently used in an investigation of the water (between approximate depths of 200 and 1,200 metres) in the Caribbean Sea region made it possible to trace the movements and mixing of water masses entering the passages from the open Atlantic and to bring out certain details not clearly indicated by the temperature-salinity relationship.

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June 14.

Effect of Addition of Calcium on the Biological Value of the Proteins of Indian Diets

During our investigations[1] on the biological value of the proteins of typical Indian diets, it was found that the proteins of the Madras diet gave a biological value of 44 at 10 per cent protein level, though rice with a biological value of about 83 formed the major item of the diet. In the course of an informal discussion with Dr. W. R. Aykroyd, director of the Nutrition Laboratories, Coonoor, he suggested that the low biological value might be due to a low content of calcium in the diet. Experiments were conducted with addition of calcium in the form of calcium carbonate to the Madras diet. Results are given below:

Calcium in diet, 0·124 per cent.

Rat. No.	Initial weight (gm.)	Final weight (gm.)	Digestibility (%)	Biological value (%)	Average
1	130	134	59	34	
2	115	123	65	45	
3	165	169	61	45	44
4	123	130	64	44	
5	114	119	66	45	
6	94	103	69	52	

Calcium in diet, 0·124 per cent + 2 per cent calcium carbonate.

Rat. No	Initial weight (gm.)	Final weight (gm.)	Digestibility (%)	Biological value (%)	Average
1	105	109	86	66	
2	102	107	93	81	
3	109	125	85	71	76
4	105	114	87	81	
5	94	99	90	79	
6	122	130	92	78	

Examination of the above results reveals that the biological value of the proteins of the Madras diet increases from 44 to 76, and the digestibility from 64 to 89 on the addition of calcium to the diet, even though the calcium content in the Madras diet is just enough according to Sherman's accepted standard for an adequate diet. The low biological value in the first table might be due to the non-availability of calcium in the diet. Further work to confirm the above observation is in progress.

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Y. V. S. Rau.

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[1] "Contributions to the Study of the Biological Value of the Proteins of Typical Indian Diets. I. Biological Value of the Proteins of Madras, Bombay (Parsi) and Punjab Diets" (sent to the *Indian Journal of Medical Research*).

Biological Fixation of Nitrogen

The oxime which is formed in the root nodules during the nitrogen fixation of legume bacteria[1] has at last been isolated and characterized. The oxime precipitates according to Foreman's method, which fact already indicates it to be the oxime of a dicarbonic acid. Extracting the oxime with ether, we succeeded in preparing the copper salt from it. The analysis of this salt showed that the compound is the oxime of oxalacetic acid. Thus the formation of aspartic acid in the biological fixation of nitrogen via the oxime of oxalacetic acid has been finally confirmed.

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June 25.

[1] Nature, 141, 748 (1938).

Electric Lines of Force

When a piece of cotton wool is placed on one of the charged spheres of a Wimshurst machine, it is immediately repelled, and, following the lines of force in the air, proceeds to the oppositely charged sphere. This is the usual method of demonstrating the phenomenon, but it is not always easily controlled.

I have recently been trying substitutes for the cotton wool, amongst them the down of birds. The down was furnished by my budgerigar. I find that the down attached to the base of the feathers which the bird pulls out answers the purpose admirably. A piece of this, placed on a charged sphere, gradually takes up the charge, the fine points of the immature feather standing out, and finally leaps across the four or five inches of air separating the two charged spheres. If the spheres are not highly charged, it may be as long as five seconds or so before the repulsion takes place.

The way the charge is taken up is extremely interesting and worth projecting on a screen. The down is a poor conductor with many fine points I think this explains its peculiar behaviour.

The electric lines of force are well shown by this method as it is possible to have two or three pieces of down going to and fro at the same time.

J. Baxenden.

Sir John Cass Technical Institute,
Jewry Street,
Aldgate, E.C.3.
June 9.

Points from Foregoing Letters

From the rate of sedimentation (in an ultracentrifuge) of the serum proteins of various vertebrate animals, Prof. The Svedberg and K. Andersson infer that the serum proteins of mammals, reptiles, birds, amphibians and fishes are very much alike, as regards molecular weight, but differ from those present in the serum of Cyclostomata (lampreys).

A new dye, dunnione, found as a deposit on leaves and flowers of *Streptocarpus Dunnii*, is described by J. R. Price and Prof. R. Robinson. It crystallizes in orange-red needles, has the molecular formula $C_{12}H_{14}O_3$, and belongs to the naphthalene group.

The copper found in human blood occurs in the form of a copper-protein compound, according to Dr. T. Mann and Prof. D. Keilin, who announce that they have isolated from the red blood corpuscles of the ox a pure crystalline compound (hæmocuprein) containing 1·12 per cent sulphur and 0·34 per cent copper.

A new 'hybrid' hæmoglobin (choleglobin) formed by special treatment of hæmoglobin - ascorbic acid solution is described by Dr. R. Lemberg, J. W. Legge and W. H. Lockwood. The new compound, like hæmoglobin, combines reversibly with oxygen and carbon monoxide, but the non-protein part of its molecule is a bile pigment, closely related to verdohæmatin.

H. S. Corran and Dr. D. E. Green describe the isolation from cow's milk of a flavin-protein compound which catalyses the oxidation of reduced coenzyme I by carriers. The mechanism of the catalysis does not seem to involve alternate reduction and oxidation of the flavin moiety.

A new enzyme which hydrolyses naringin, the bitter glycosidic principle of grape-fruit, may be readily obtained from celery, according to Dr. D. H. Hall. It also occurs in the grape-fruit itself between the flavedo and albedo, where it probably helps to reduce the bitterness of the fruit on ripening.

Dr. H. G. K. Westenbrink and Dr. J. Goudsmit have determined, by a modified thiochrome method, the relative amounts of the two forms of vitamin B_1 (aneurin and cocarboxylase) in various organs of the rat and find that the aneurin content is small compared with carboxylase.

Dr. J. H. Welsh states that the acetylcholine found in the nervous tissue of the crab has upon the heart of that animal an effect opposite to that upon the human heart, namely, it increases the rate of beat.

T. L. Snyder and R. H. Broh-Kahn find that cysteine can replace hæmin as the X-factor enabling *H. influenzæ* to grow, and consider that its function is to provide the organism with a mechanism for protection against the hydrogen peroxide formed in the presence of air.

Diagrams showing the average density of population and the composition of the insect fauna at heights of 277 ft., 177 ft. and 10 ft. above an area of agricultural land in Lincolnshire is submitted by J. A. Freeman. The greatest numbers and variety occurred during the months of June and September, and the most favourable conditions were high temperature, low humidity and wind velocity. A list of the more common pest species taken up to 277 ft. is given and the economic importance of their presence is discussed with reference to ground quarantines.

Dr. R. W. G. Dennis observes that the potato virus Y induces brown circular local lesions in the leaves of *Lycium barbarum* seedlings, and suggests that this reaction may prove of value as a new test for the Y-virus.

For several years, Dr. T. Burrow and his associates of the Lifwynn Foundation have been experimenting with differences in physiological reaction according (1) as behaviour is motivated naturally by the organism as a whole, or (2) as it is prompted by secondary part-components giving rise to neurotic phantasies and related behaviour-disorders.

Diagrams of chromosomes from the root-tip cells of the saffron during mitosis are submitted by Prof. R. R. Gates and G. N. Pathak, in which the double structure of the chromosomes is rendered evident by the presence of 'satellites'. The authors state that by means of a new method which stains the chromatin red and the nucleolar material green, the origin of the nucleolus from the split chromosomes can readily be followed.

Curt Stern states that he has shown by means of transplantations of testes between two species of *Drosophila* that the distinguishing characteristics in testicular shape are induced by a difference in the male ducts.

The non-ionizing penetrating radiation producing cosmic ray secondaries and showers is considered by N. Arley and Dr. W. Heitler to be a neutral body corresponding to the heavy electron. The authors suggest for a new entity, which has a mass intermediate between the neutron and the neutrino, the name neutretto, and discuss its likely properties in the light of present theories.

Prof. H. R. Robinson points out that when the most recent values of the coefficient of viscosity of air are used, Millikan's oil-drop value of the electronic charge comes into almost exact agreement with the X-ray value, namely, $4{\cdot}803 \times 10^{-10}$ E.S.U.

Starting with the solution for the 'electron velocity ripple' in terms of the transit half-angle, W. E. Benham points out that the ripple satisfies a five-dimensional wave equation.

Dr. U. R. Evans describes a treatment which renders iron relatively inert to ordinary waters, the time taken to produce rustiness being sometimes 100 times that needed by untreated iron in the same water. The protective film is invisible, and the engraving of a scratch-line after treatment does not necessarily lead to rusting, probably because it presses down the film into the groove.

Solutions of the copper salt of cetyl-phenyl-ether sulphonic acid and other salts of the newer paraffin-chain series, show elastic behaviour similar to that of ammonium oleate solution, when they are set in motion. According to Dr. G. S. Hartley this is the opposite of thixotropic behaviour, and has been explained by Hatschek as due to the formation of amicroscopic structure by the process of shear.

H. A. and Dr. R. C. Shah have formulated polyhydroxy phenols by a modified Gattermann reaction. The 3-substitution is explicable on the assumption of the stabilization of the double bonds in the nucleus by the chelation between the hydroxyl and the acetyl groups.

40° N., following a course: New York—Paris—Moscow — Omsk — Yakutsk (Siberia) — Fairbanks (Alaska)—Minneapolis—New York. They covered a distance of 14,874 miles in 3 days 19 hours 17 minutes. Their actual flying time was 71 hours 4 minutes at an average speed of 209 miles an hour. They followed a somewhat similar route to that taken by the late Wiley Post, the American aviator, who established a record of 7 days 18 hours 49 minutes for a flight of 15,250 miles in 1933. Their machine was a Lockheed '14' monoplane, powered by two 875 horse-power Wright 'Cyclone' engines with Hamilton constant speed airscrews. Normally this type is a 14-seater air liner carrying 12 passengers and 2 crew. While this is a meritorious performance, having been completed in only seven stages, it is not a record for long-distance non-stop flight. The longest 'hop' was New York–Paris, a distance of 3,641 miles.

SUCH a performance pays tribute principally to the technical improvements that have added to the reliability of the engines, and the rapid strides that have been made recently in the methods of, and aids to, aerial navigation. It is significant of the development of this side of aviation that even in the less developed parts of Siberia, there were sufficient aerodromes and radio organization to allow of a choice of landing grounds after being given reports upon their condition while flying towards them. The extra carrying capacity consequent upon developments in aerodynamic knowledge plays its part in allowing various aids to flying and navigating to be carried, and also making it possible to have cabin accommodation sufficiently large for the crew to move about and to carry out their duties without undue strain. In one instance, in Siberia, during this flight it is reported that they even had room to carry an extra supply of more than 500 lb. of oil, as it was reported that the particular grade that the engines needed would not be available at the next stop. It is interesting to note that the engines used on this flight are of the same type as those fitted to the Lockheed aircraft recently ordered by the British Government.

'Aryans' in Italy

NATIONALIST doctrine in Italy hitherto has had the appearance of avoiding pronouncement upon theories of race. It has relied rather on fostering the totalitarian spirit upon imperial tradition with a consequent orientation to archæological research, for which the learned world is duly grateful to the personal interest of the Duce. Now, however, it is said to be time that the Italians frankly professed themselves to be "racist". A group of university professors, it is reported (*The Times*, July 15), working under the auspices of the Ministry of Popular Culture, has drawn up a pronouncement, appearing in the *Giornale d'Italia* of July 14, in which is stated what is to be regarded henceforth as the orthodox view of racial doctrine as applied to Italy. This statement has the merit that it recognizes that the idea of race is a purely biological concept, with which history, language and religion have nothing to do. It claims that the present population of Italy is in its majority Aryan, few elements of the pre-Aryan races remaining, and no immigration of populations capable of influencing the racial physiognomy of the nation having taken place since the Lombardic invasion. The forty-four million of inhabitants of Italy to-day, it is maintained, are for the most part descended from families which have been established there for at least a thousand years. While this may be conceded, but only so far as it goes, the inference that the Italian race—a term which in itself begs the question—can thus be regarded as a pure race is perhaps less readily to be accepted. The corollary that racism in Italy ought to be "essentially Italian with an Aryan-Nordic direction" is a hard saying, only partially intelligible, especially in view of the repudiation of linguistic evidence, in the light of the evident desire to dissociate the Italians from other members of the Mediterranean racial group by emphasizing its purely European characteristics as marking it off from all extra-European races. This view would ignore or deny any trace of kinship between the Mediterranean strain in the Italian and that in the peoples of North Africa, Arabia, and Palestine. This would seem to require a somewhat drastic re-interpretation of the facts.

The Deutsche Orient-Gesellschaft

A NOTICE from the Deutsche Orient-Gesellschaft, of which the following is a translation, has reached its members, including British subjects and honorary members. "To the Members of the German Orient-Society. To ensure the continuance of the German Orient Society, the Executive Committee must, in accordance with Paragraph 8 Section d of the Constitution, give those members who rank as Jews in the sense of the Nuremberg Laws, to understand that they must announce their resignation from the German Orient Society within 14 days." The notice is signed by Dr. F. Schmidt-Ott (vice-president) and Dr. W. Andrae (secretary) of the Society. Though the Society has been compelled by the policy of the Government to take this step of asking Jews to resign, the wording of the announcement is altogether unworthy of a scientific body and is particularly unpardonable when sent to members who are not Germans.

THE Deutsche Orient-Gesellschaft was formed in 1898, mainly under the inspiration of Prof. Friedrich Delitzsch, a Jew in the sense of the Nuremberg laws. The main aims of the Society were to excavate ancient sites and survey ancient monuments in the Near East and Egypt. Three great sites in Iraq have been carefully examined over a long series of years—Babylon, Ashur and Uruk—and many other smaller sites sounded. In Egypt, excellent work was done at el Amarna and on the sepulchral monument of Sahu-Re. Surveys of Ukhaidhir, the ancient synagogues of Palestine and Islamic monuments in India were perhaps the most important contribution to these subjects. Regular "Mitteilungen" kept sub-

scribers informed of progress. Final reports, and most important publications of the texts found were included in the "Wissenschaftliche Veröffentlichungen". These undertakings were generously supported in Germany by such men as the late Dr. Simon, and foreign subscribers were numerous. For forty years the Deutsche Orient-Gesellschaft has held a leading place among societies of its kind, always insisting on a high standard of work in the field and the study not always attained by others. Sir Robert Mond was one of the foreign members who received the letter asking for his resignation and he informs us that he has answered, "that since your Council has unanimously decided to cease to be a scientific society, he no longer desires to be associated with it".

Archæological Exploration in South-West Arabia

IN another column of this issue of NATURE (see p. 140) a preliminary account is given by Miss G. Caton-Thompson of the geological and archæological results of the Lord Wakefield Expedition of Exploration in South-West Arabia, upon which she recently accompanied Miss E. W. Gardner, the geologist, and Miss Freya Stark, whose adventurous journeying in Arabia on a previous occasion will be fresh in the memory of readers. Miss Caton-Thompson, whose present record amplifies in detail the archæological and geological references of Miss Stark's account of the expedition in *The Times* of July 18–21, is far from being a novice in archæological exploration in conditions similar to those of her recent experience. With Miss Gardner as her geological colleague, she has investigated the evidences of early civilizations in the Faiyum and the Kharga oasis, while in Southern Rhodesia she has attacked, and, most archæologists would agree, has solved the problem of the Zimbabwe. In venturing with her colleagues into the rarely penetrated Hadhramaut she has initiated the archæological investigation of a problem, or group of problems, which has fascinated historian and geographer ever since the explorations in southern Arabia of Niebuhr in 1761–64 and of Halévy and Glaser more than a century later revealed in their collection of inscriptions the existence there of civilizations going back possibly so far as nearly a thousand years before Christ. Yet the archæological record has remained virtually blank, and although the great frankincense route from India to the eastern Mediterranean through southern Arabia traversed country known to the ancient world of Sumer, Akkad and ancient Egypt, it may be, in the third millennium B.C., nothing is known with certainty of the cultures and relations of those civilizations. Minæan, Sabæan, Himyaritic, and the like, which Miss Caton-Thompson, wisely, for the moment accepts collectively as pre-Islamic. The work of Miss Gardner and herself in the Hadhramaut has laid securely the foundations for the study of a group of problems which recent development in the pre- and protohistoric archæology of western Asia and Africa suggests may be one of the most important strategic points in future research.

Excavations at Lachish, 1937-8

THE interesting collection of antiquities from Tell Duweir, the ancient Lachish, in Palestine, on view at the Wellcome Research Institute, Euston Road, London, N.W.1, from July 7 until July 29 bears eloquent testimony to the organization of detail by the leader of the expedition, the late Mr. J. L. Starkey, which enabled the members of the Wellcome-Marston Archæological Research Expedition to carry on without interruption after his murder on January 10 last. By that time the expedition had already arrived as near a solution as is likely to be possible of the problem of the great shaft, 80 ft. by 70 ft. by 80 ft. deep, at the south-east corner of the Tell upon which investigation was engaged at the close of last season. Tunnels driven along the sides at the bottom and up to the centre show that this great seventh century work was never completed, but that it was probably intended for a reservoir similar to that at Gezer. Excavation of the Bronze Age temple has now been completed down to bed rock, two pieces of evidence leading to redatings.

THE early temple is now shown to be considerably earlier than was believed, a remarkable large polychrome pot with painted metopes, showing beautiful representations of ibex, ibis and tunny fish, being placed in a class of pottery dated by Mr. W. A. Heurtley at about 1550 B.C.; while a small faïence plaque of Amenhotep III was found in such a position as to place it beyond question that the building of the second temple falls within the reign of that monarch. Two Nineteenth Dynasty pottery sarcophagi, the first found at Lachish, in the form of 'slipper' coffins, have lids moulded to represent the features of the deceased, while a third bears an inscription in hieroglyph which is unique. It is by a scribe evidently unfamiliar with hieroglyphic writing, and although not yet fully interpreted, is in a formula which is not Egyptian. Early Bronze Age caves, dating at about 2500 B.C., showed evidence of occupation, as well as contracted burials. In one cave, of the Late Bronze Age, which in Judæan times had been used as a stable, was found a number of unfired pots which pointed to this having been a potter's workshop, while nearby in another cave was his stock-in-trade. In a pit were pivoted stones which may have served as fly-wheels for the turn-table, while red and yellow ochre for painting, bowls for mixing the paints, pebbles and shells for polishing and burnishing, were part of the equipment. The interesting schoolboy scribing giving the order of the first four letters of the Judæo-Phenician script was found under the Jewish Palace steps the day the expedition ceased work.

Archæological Research in Greece

AMONG recent excavations and research in Greece recorded in the Annual of the British School of Archæology at Athens (**35**, Session 1934–35), first place in interest and importance is taken by the work of the School in Ithaca. Mr. W. A. Heurtley, who was in charge, describes the results of the excavation of

the Helladic settlement at Pelikáta, which Leake and others have identified with the home of Odysseus as described by Homer. Pelikáta is a hill or spur linked on one side with the central peak of the island, and sloping down to the sea in a series of terraces on its three other sides. Thus commanding three bays, and having a flat top, it was, as Mr. Heurtley points out, an admirable site for a primitive community interested in trade or piracy or both. Virtually no trace of buildings remained when investigation began; but there were vestiges of the wall which had enclosed the promontory. Excavations on the site yielded evidence of an early Helladic settlement, which on the evidence of the pottery, Mr. Heurtley concludes, reached the island in Early Helladic II from Corinthia, and afterwards received an accession in a new element in the population, which Minyan ware indicates to have come from the south of Thessaly as its immediate place of origin, with an ultimate derivation from Bronze Age Macedonia.

THE date of the original occupation of Pelikáta is placed at about 2200 B.C. the settlement then being a simple affair—a wall of rough stone blocks surrounding a group of houses with rubble walls and roofs of reeds daubed with mud, situated on top of the hill. These people buried their dead, or rather the bones of their dead in *pithoi* or jars, which, possibly, were placed below the floors of the houses. The settlement came to an end at about the time which tradition assigns to the Trojan wars, and thus, Mr. Heurtley remarks, those who hold on other grounds that Pelikáta is to be identified as the site of the palace of Odysseus now have some archæological evidence to support their contention. A cave containing stratified deposits on the north-east of the bay of Polis was excavated by Miss Sylvia Benton, and showed evidence of occupation from pre-Mycenæan times to the first century A.D. It was a shrine at which various deities were worshipped, but its local importance seems to have been due to a connexion with Odysseus, for which there is evidence in an inscription on a female mask.

Garden Plants of Proved Excellence

THE Council of the Royal Horticultural Society established, in 1922, an Award of Garden Merit, as a hall-mark upon the horticultural worth, hardiness and beauty of particular plants. Notes and descriptions of species which have attained to this particular quality have been published from time to time in the Society's *Journal*; but it was a welcome decision of the Council to publish the collected awards during the past fifteen years in a separate volume ("Some Good Garden Plants", by F. J. Chittenden. London: from the Society's Offices, Vincent Square S.W.1. 1938. 4*s*. net). The plants described therein have mostly been grown in the Royal Horticultural Society's gardens at Wisley, and are all well known to the Garden Committee. A horticultural description, cultural notes, and suggestions for suitable garden grouping, are appended for each of the 225 species or varieties, and the most suitable soil types are mentioned. References are also given to plates in the *Botanical Magazine*, when the plant has been so figured. Some kinds, as *Lilium regale*, *Dicentra spectabilis*, *Primula denticulata*, *Daphne mezereum* and *Clematis montana* are already well established in favour; other species have recently been introduced to culture from plant-collecting expeditions, whilst yet others are improvements of very common plants. *Ulex europaeus flore pleno* is a double variety of the common gorse, *Caltha palustris plena* is a dignified form of the wild marsh marigold, and three improved varieties of the common lilac are described. An alphabetical arrangement assists quick reference, whilst an index divided into annuals, bulbous plants, herbaceous perennials, rock plants, shrubs, small trees, wall and climbing plants, and water plants, enables the gardener to find his way easily among these aristocrats of the garden.

Child Psychology for Parents

WE have received a copy of an address delivered recently to the parents' association of a school well known for its pioneer work in the field of organized practical training for citizenship. The address is noteworthy if only as a too rare example of effort towards parent–teacher co-operation. The author, Dr. Oswald Schwarz, sought to demonstrate what he described as one of the greatest discoveries of modern psychology—that the foundations of happiness in later life as well as of all troubles, difficulties, problems and abnormalities, are almost invariably laid in the first few years of our childhood. The only real problem in education is, he holds, the problem of an aim in life and its solution is to be sought in evoking and fostering an attitude of respect, or "the appreciation of the inherent value of everything existing just because it exists". He shares, apparently, with Whitehead the notion of actuality as in its essence a process, involving, on the mental side a weaving of reception and anticipation into an end to which its indwelling Eros urges the soul as to the realization of ideal perfection. To the objection that such philosophical ideas do not work with children he answers that he knows "from fairly wide personal experience that most boys from the age of sixteen years onwards are not only able to conceive these ideas but that they grasp them eagerly as if they had long waited for them"; which accords with Whitehead's "youth is peculiarly liable to the vision of that Peace which is the harmony of the soul's activities with ideal aims that lie beyond any personal satisfaction".

The Brotherton Collection of the University of Leeds

THE second annual report of the Brotherton Collection Committee refers to the considerable interest in the Brotherton Collection which is available for the use of the University of Leeds staff, students, research scholars and the public. The numerous exhibitions which have been arranged, including technical exhibitions for the Process Blockmakers' Society, Printers' Guild, the Technical Institute, and the Society of Chemical Industry, have attracted some 2,300 visitors. Detail work such as

lighting and heating adjustments, painting and additional fittings, which was incomplete at the opening of the Library in October 1936, was completed by the end of the Easter vacation. Good progress was made with the catalogue and cross-reference index. The income of the Library is limited to about £1,250 per annum and the accounts show a balance in hand of £96 8*s*. Particulars of gifts and additions during the year and of the regulations governing access to the Collection are included.

British Scientific and Technical Books

THE second edition of the "Select List of Standard British Scientific and Technical Books" has been prepared by the Association of Special Libraries and Information Bureaux, at the request of the British Council (ASLIB, 31 Museum Street, London, W.C.1. Price 2*s*. to "Book-List" Subscribers; 2*s*. 6*d*. to others; 1*s*. to members of ASLIB or the Library Association). In the preparation of the list, the Book-List Committee consulted authorities upon every subject, so that the books may be justly regarded as representative of existing works in science and technology now available from British publishers. About three hundred books are included in the list, which is subdivided into twenty-three sections. Sections on agriculture and on medicine and surgery have been added in the revised edition. A list of publisher's addresses and a subject index are appended.

Beit Fellowships for Scientific Research

THE following Beit fellowships for scientific research, tenable at the Imperial College of Science and Technology during the Academic Year 1938–39, have recently been awarded: extensions of fellowships already satisfactorily held for one year to D. W. Goodall, for research on the physiology of the tomato plant, under the direction of Prof. F. G. Gregory; H. A. C. McKay, for investigations of chemical problems by the radioactive indicator method, under the direction of Prof. H. V. A. Briscoe; A. K. Powell, for research on parasitic wasps, in particular that of *Microbracon hebetor*, under the direction of Prof. J. W. Munro. New fellowships tenable for one year but renewable for a second have been awarded to J. L. O. G. Michiels (Royal College of Science), for research on the positions and widths of the energy levels of atomic nuclei by means of experiments on the capture of slow neutrons by various elements, under the direction of Prof. G. P. Thomson; E. J. Harris (Royal College of Science), for research on hydrocarbon oxidation and the reactions of peroxides with reference to carbon processes, under the direction of Prof. A. C. G. Egerton.

Announcements

DR. MONTAGU TRAVERS MORGAN, medical officer of the Ministry of Health, has recently been appointed medical officer of health of the Port of London by the London Corporation.

AN exhibition dealing with the prevention of industrial eye diseases was opened at the Royal Eye Hospital, London, on June 22 by the Earl of Athlone. Part of the exhibition is to remain in the hospital as a permanent museum.

AN intensive course in industrial hygiene and medicine will be held at the University of Birmingham on September 12–23. Further information can be obtained from Dr. H. E. Collier, Department of Industrial Hygiene and Medicine, The University, Birmingham.

THE Minister of Justice in Portugal has transformed the Department of Criminal Anthropology, Experimental Psychology and Civil Identification into an Institute of Criminology on modern and strictly scientific lines under the direction of Dr. Luiz de Piña.

A CONFERENCE on Plant and Animal Communities will be held at the Biological Laboratory, Cold Spring Harbor, Long Island, New York, on August 29–September 2. Three general papers will be read, and six will be read on association concepts and four on animal aggregations. These will be followed by discussion, the whole of which will eventually be published in the *American Midland Naturalist* (20, No. 1; January 1939). Further information can be obtained from the Director of the Laboratory.

THERE has recently come to hand No. 1 of vol. 8 of the *Bulletin of the Fan Memorial Institute of Biology*, Zoological Series. This journal is published by the Institute at Peiping (Peking) and the present issue bears the date March–April, 1938. It is gratifying to note that notwithstanding the present disturbed conditions in China, it is possible for scientific work to be carried out. The present number covers a variety of zoological subjects and the contributions are written in the English language by Chinese investigators, each article being accompanied by short Chinese abstracts. The illustrations are well reproduced and of a high standard.

FROM the Nottingham University College Appointments Board we have received an attractive brochure giving an outline of courses offered, a list of entrance and other scholarships and some notes on careers open to college graduates. The faculty of applied science includes departments of civil, mechanical and electrical engineering, mining and fuels, textiles and a school of architecture. For some years, every student of engineering who has satisfactorily completed his course at the College has obtained a post, and there are said to be more posts available than students to fill them. The Nottingham coalfields provide facilities to students for experience in up-to-date methods. Students of the large and well-equipped textiles department also are said to obtain positions readily with very good prospects in hosiery and yarn manufacturing firms, textile testing and research institutions and dyeing and finishing firms.

Research Items

Milk and Nutrition

An interim report to the Milk Nutrition Committee on "The Effects of Dietary Supplements of Pasteurised and Raw Milk on the Growth and Health of School Children" has been published by the National Institute for Research in Dairying. The report deals with the data obtained of height and weight at the first and last examinations of a series extending over a year, made on 6,099 school children in Luton, Wolverhampton, Burton-on-Trent, Renfrewshire and Huddersfield. The children were divided into four groups, the first (control) groups received biscuits, the second ½ pint of pasteurized milk, the third ⅓ pint of pasteurized milk and the fourth ⅓ pint of raw milk, as daily supplements to their home diets. The groups receiving milk showed greater increments in height and weight than those receiving biscuits, and, in the case of the children receiving ⅓ pint of milk, increases of 4–6 per cent in height and 9–10 per cent in weight over the control groups were found. The response to milk supplements of children, initially classed as 'well nourished', appeared to be better than in children of a lower standard of nutrition. This may be due to the utilization of the milk in making good 'structural' deficiencies before it begins to affect growth. No significant differences could be detected between the effects of raw and of pasteurized milk.

Nutrition in an African People

Notes of observations on the Elmolo of Lake Rudolf, East Africa, made by the late Dr. W. S. Dyson and written up by Dr. V. E. Fuchs, his colleague on the Lake Rudolf–Rift Valley Expedition (*J. Roy. Anthrop. Inst.*, **67**, 2; 1937), afford material for comparison with the condition of the people when first encountered by Count Teleki and Lieutenant (now Admiral) von Höhnel in 1888, since when nothing has been written about them. The contrast suggests that intensive study of the effects of an unsuitable diet on a previously healthy people and of the changed conditions in their mode of life would be of no little interest. It was recorded at the time of their discovery that they were approximately five hundred in number. In 1934, the number of men, women and children was given as eighty-nine only. The Elmolo were reputed to be poor members of three surrounding tribes, whose mode of life had been modified by extreme poverty. They live principally on fish, varied by occasional flesh of hippopotamus, crocodile and turtle. Formerly they were able to obtain a little grain by working; but Abyssinian raids cut them off from their grain supply. The only drinking water is from the lake, and as this is deficient in calcium carbonate, there is a calcium deficiency in their diet, which may have some connexion with the universal deformity of the hips from which they suffer. This has the appearance of rickets, taking the form of an outward and forward bowing of the tibia. It occurs both in adults and in a lesser degree among the children. The men suffer more than the women, possibly owing to their more active life. The anterior edge of the tibia in many appears to be thickened and rounded, a feature that might be associated with a gradual bending of the bone, causing distortion. The pains in the legs from which they suffer they treat with a burning ember placed on a piece of goat-skin and held on the limb until it burns through to the flesh.

Racial Characters in Jews of Cochin

There are in Cochin two groups of Jews, "White" and "Black", with a third obviously of mixed origin, the "Brown", all claiming to be descended from Jews who migrated from Palestine on the destruction of the Temple by Hadrian in A.D. 70. Both groups are in theory endogamous, and the White Jews have evidently maintained their segregation, inter-marrying closely over a prolonged period; while the Black Jews, there is evidence to show, have introduced low caste Indian women into their community. An investigation of the blood groups and the physical characters of the White and Black Jews by Dr. Eileen W. Macfarlane (*J. Roy. Asiat. Soc. Bengal, Letters*, **3**, 1; 1937), though dealing with rather limited numbers, elucidates several points of historical and sociological interest. The distributions of the blood groups in the three Jewish communities are completely dissimilar; but the data for the Brown group are disregarded as there are so few. The White Jews show a preponderance of Group *A*, due to the very high degree of interbreeding. A comparison shows that *A* is high in Jewish communities in the Near East. The Black Jews show an even more unusually high percentage of Group *O*. Similar high percentages have been recorded only in very ancient races, such as the Australians and Amerinds; but there is a similar high percentage among the low castes and outcastes of Ernakulam, among whom the Black Jews have lived for hundreds of years, and from whom they have taken wives and concubines. Thus evidence from blood groups and physical characters shows that the claims which each Jewish community makes about itself, combined with what each says of the other, are probably true. The White Jews preserve a Near East and European Semitic strain with no Indian admixture, while the Black Jews are the descendants of mixed Semitic and native Malayali ancestors.

Eelworm Disease of Wheat

Eelworm disease of wheat was first recorded in Egypt in 1919, but considering its distribution at that time, it is probable that it had existed in the country some years before. In 1926 the areas attacked had increased sufficiently to warrant the need for Government control measures, and although these were successful locally, widespread outbreaks of a severe nature occurred in 1932. A more thorough investigation into the disease, its means of spread and methods for its control were accordingly made, and are now described by G. Howard Jones and Abd El Ghani Seif El Nasr Eff. (Bull. 180, Technical and Scientific Service, Ministry of Agriculture, Egypt). From a knowledge of the life-history of this eelworm (*Anguillulina tritici*), the almost exclusive means of spread of the disease is from seed containing a mixture of the characteristic hard galls, which form in the ears of attacked plants. Under the moist conditions of germination larvæ, which immediately

attach the surrounding wheat seedlings, are liberated from these galls. Control measures, therefore, amount to ensuring that seed is free from galls before sowing. Hot water steeping, though successful, is regarded as impracticable on the large scale. The same disadvantage applies to the flotation treatment in which galls can be separated from seed by the difference in their specific gravity in 20 per cent brine. Mechanical cleaning by means of indented cylinders or "trieurs", gave the best results. These machines effect separation by differences in shape, rather than by size or weight, and were found to give an efficiency of more than 97 per cent when used for cleaning eelworm-infected seed.

Angiosperm Embryo Sacs

P. MAHESHWARI (*New Phyt.*, **36**, No. 5; 1937) has published a review of the variations occurring in the angiosperm embryo sac. The data recorded represent a considerable search in the literature, and the facts are presented in a more generalized form than in K. Schnarf's "Vergleichende Embryologie der Angiospermen". The method of describing the embryo sacs as monosporic, bisporic or tetrasporic according to the time of origin of the embryo sac relative to the two divisions (reduction division), normally occurring in the megaspore mother cell, is useful for classification purposes. The data contribute little towards the elucidation of the problem of the homologies of the angiosperm embryo sac. Reports from some recent workers that the synergids are derived from one nucleus and the ovum and upper polar nucleus from a second, tend to favour the first part of Porsch's view that the two synergids, ovum and upper polar nucleus, represent one archegonium; but there seems little evidence that the remaining nuclei represent a second archegonium.

Downy Mildew of the Antirrhinum

THE antirrhinum plant, which seems to have largely overcome the menace of attack by its specific rust fungus, has recently been threatened by another fungal parasite, closely allied to *Peronospora antirrhini*. The new attack occurred in Sussex, and Mr. D. E. Green has recently described it (*J. Roy. Hort. Soc.*, **63**, Pt. 4, 159–165, April 1938). Symptoms are of the downy-mildew type; infected plants are dwarfed, and the shoots appear somewhat bunched, whilst mealy-white patches occur upon the under-sides of the leaves. Conidia and oospores are described; but little more can be said about the disease, for, having regard to the serious nature of attacks in other countries, the Ministry of Agriculture requested, and accomplished, the total destruction of all plants infected in Sussex.

Alaska Earthquake of July 22, 1937

MR. E. H. BRAMHALL has recently given a brief account of this important earthquake in central Alaska (*Bull. Seis. Soc. Amer.*, **28**, 71; 1938). Though the country is sparsely inhabited, it was found possible to trace the boundary of the disturbed area, and to show that it contained about 300,000 square miles and that its centre lay near Salcha and probably a few miles to the east of that town. During a flight made over the central region on July 24, what appeared to be a narrow path, about ten miles long and running north and south, was seen a few miles beyond Salcha, but its nature could not be definitely settled. The epicentre of this earthquake thus lay more than 300 miles to the north-west of that of the great earthquake of September 10, 1899, and the shock does not seem to have been felt so far as Yakutat Bay, the central region of the earlier earthquake.

Geology of British Graham Land

SOME indication of the geological results of Mr. J. Rymill's British Graham Land Expedition, 1934–37, are noted by Mr. W. L. S. Fleming in an article in the *Geographical Journal* of June. Geological work was confined mainly to the coast where outcrops could be reached. Only a few specimens were obtained from the interior of Graham Land. With the exception of part of Alexander I Island, the area showed igneous and metamorphic types. Granites and granoderites occupy a large area in West Graham Land, but volcanic rocks are also common. It is clear that the homology with the Andean cordilleras of South America applies to South Graham Land as well as North Graham Land. The eastern coast of Alexander I Island, except perhaps the extreme north, consists of limestones, calcareous grits and shales. Invertebrate and plant fossils were found, but though they were too fragmentary to be identified they seem to resemble, at least as regards the plant remains, specimens obtained many years ago by Dr. O. Nordenskjöld from the Jurassic beds of Hope Bay on the east of Graham Land. This was the only island off the west coast of Graham Land containing unmetamorphosed stratified rocks. All others examined proved to be of the same formation as Graham Land.

Structure of Hailstones

MR. R. P. JOHNSON, of the Research Laboratory, General Electric Co., Schenectady, New York, has sent an account of a fall of broken hailstones in a thunderstorm that visited Washington, D.C., shortly after noon on April 29, 1938. The shapes of these stones and their stratification showed plainly that they were fragments of larger spherical stones about 30 mm. in diameter, in which clear and cloudy layers had alternated about every 2 mm. Photographs which appeared in newspapers of the stones that fell elsewhere in this storm showed that these were spherical, and that they damaged greenhouses and the roofs of automobiles. It was concluded that where fracture took place it was at a high level, for the pieces, which ranged up to 15 mm. in size, appeared to have terminal velocities suited to their sizes. They did not break on striking the pavement. The absence of layers of clear and cloudy ice built on to each fragment seemed to prove that the stones were fractured below the region where they were formed. The remarkable fact that all the stones were broken at the place of observation, while two miles away only complete stones fell, suggested to Mr. J. Schremp (another of the research engineers of the G.E.C.) that the shattering was caused by a pressure wave that was set up by a bolt of lightning that passed near to them as they fell. These observations are a valuable contribution to the known facts about hailstones that mathematicians who seek to explain their formation must take into account.

New Case of Chemi-luminescence

J. H. HELBERGER reports an interesting new example of chemi-luminescence (*Naturwiss.*, **26**, 316; 1938). When the complex magnesium salt of phthalocyanine is added in small quantities at a time to gently boiling tetralin an intense red glow is observed.

The glow remains for a few minutes. The process can be repeated until further additions of the compound fail to produce the glow, and the magnesium phthalocyanine dissolves normally with its green colour. If now benzoyl peroxide or hydrogen peroxide is added to the liquid in small quantity, or if air is passed through, the boiling liquid once more glows. It appears, therefore, that peroxides present in commercial tetralin are responsible for the chemiluminescence. Other magnesium complexes (for example, the magnesium compound of tetrabenzoporphin) and zinc complexes (for example, those of phthalocyanine, tetrabenzoporphin and mesoporphyrin) also give the red glow, but not with such great intensity. The copper and iron complexes and the free pigments do not show the effect. The phenomenon may prove of interest in connexion with the problem of assimilation.

Frosting of Aeroplane Wings

Two dangers of modern air transport are fog and frost deposits on the wings. The risk of airport landing in a fog has been practically eliminated by the use of radio beam direction finders and now, according to the *Beama Journal* of June, two French engineers, MM. Rideau and Ducret, have invented a method of de-icing the wings by the application of electric currents. The main difficulty lay in finding resistances which could be made pliable enough to cover curved surfaces without diminishing the value of the resistance. Satisfactory results have been obtained by spraying a colloidal dope, composed of a volatile solution, which contains in suspension laminated graphite of low conductivity, on the wings. The surface was first insulated from the rest of the plane by means of a layer of treated paper. Selected portions of the wings were then covered by protecting strips and the remaining surface sprayed with the dope. After the wing surface had been covered with the resistant solution, the protecting strips were removed and along them by means of a pistol sprayer, metallic particles were sprayed to form continuous bands for distributing the electric current. As a final protection the whole surface to be treated was painted over with a coating of varnish. On the basis of laboratory tests, it is claimed that in an aeroplane of 15 metres wing span, normal speed, 300 kilometres per hour, the band to which the de-icing system should be applied need not be wider than 20 centimetres. If the plane were provided with a four kilowatt generator, ice deposit could be prevented up to fog temperatures of 5° C. below zero. With temperatures 5°, 10° or 15° C. below zero, it should be possible to detach ice in 50, 90 or 130 seconds respectively.

Production of Hydrocarbon Oils from Industrial Gases

DR. W. W. MYDDLETON, in a paper read to the Institute of Fuel on May 12, described the above process developed by Messrs. Synthetic Oils, Ltd. The chief difference between this and other processes lies in limiting the hydrogenation reaction which leads to conversion of the first product of synthesis ('primary' oil) so that motor spirit and Diesel oil are produced without the aid of a cracking plant; at the same time a considerable quantity of material is available for the production of lubricating and transformer oils. Also, with this process, it has not been found necessary to adjust the ratio of carbon monoxide to hydrogen in the gas. Suitable gas can therefore be obtained from a majority of solid fuels, and one plant can handle widely different types. The need for coke ovens or supplementary water gas plant is thus entirely eliminated. A commercial plant capable of producing 136–180 gallons per day of synthetic oil is in course of erection at Bedley Colliery near Glasgow, and the results of first trials are awaited with considerable interest.

Construction of a Schmidt Camera

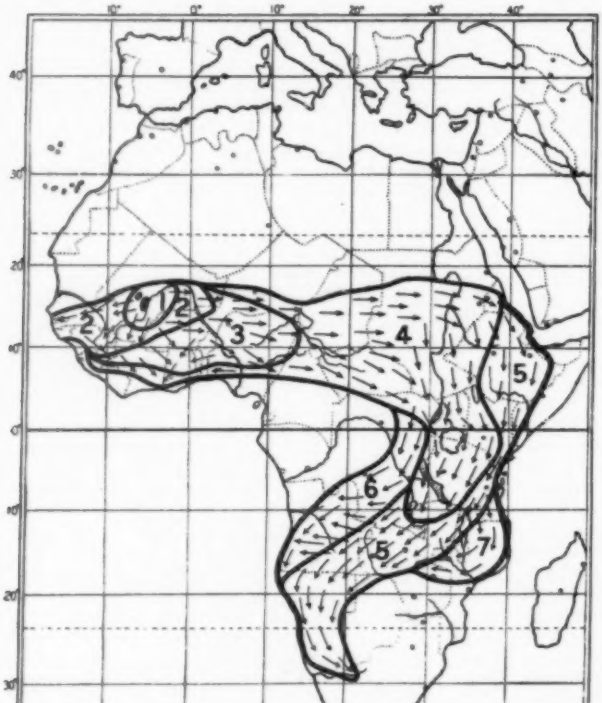
MESSRS. H. W. and L. A. Cox have recently published a paper with the above title (*J. Brit. Ast. Ass.*, **48**, 8; June 1938), which briefly describes the principle of the Schmidt camera and then provides very full details of their own camera constructed on similar lines. The grinding of the spherical mirror, and also the method for testing the short-focus sphere, are described, and then follows an account of the making of the correcting lens and the procedure for testing its accuracy. Many other details are supplied which will be very useful to those interested in celestial photography and in the construction of a similar instrument, and it will repay them to study the paper carefully if they are to avoid numerous pitfalls and difficulties. Photographs taken show that the coma is satisfactorily corrected and that the star images over the negative are small. Although a slight amount of astigmatism appears at times, as this is probably due to uneven film, inferior following, or possibly small distortion in the mountings, it is possible to correct this blemish later.

Colour Temperature Variations of Stars

W. M. H. Greaves and E. Martin have published a paper entitled "Colour Temperature Variations of γ Cassiopeiæ, and the Problem of the 'Yellow' B-Type Stars" in which they give the gradients measured from plates taken in 1926–27 and also the gradients derived from the more recent plates taken in 1936–37, of the above star (*Mon. Not. Roy. Astro. Soc.*, **98**, 6; April 1938). The remarkable increase in brightness during 1936 was accompanied by a decrease of colour temperature and a strengthening of the intensities of the emission lines, and the same phenomenon took place between the autumns of 1936 and 1937. The change of colour temperature places γ Cassiopeiæ in the category of 'yellow' B-type stars to which group Hertzsprung directed attention in 1923. The problem of this type of stars is discussed, and the objections to certain theories are briefly stated. Previously, it was pointed out that the colour temperatures appear to be correlated with the intensities of the interstellar *K* line, the low temperature stars having strong interstellar lines, and selective absorption or scattering in interstellar space was suggested as the cause of the reddening effect (*Mon. Not. Roy. Astro. Soc.*, **89**, 125). Gerasimovič criticized this view and showed that some of the stars of the group under discussion were characterized by enhanced emission or diminished absorption on the ultra-violet side of the Balmer series limit, and concluded that the low colour temperatures were intrinsically connected with the more luminous stars of B-type. The subject has been investigated by others, and it is probable that not only is there a reddening due to selective space absorption, but, in addition, there is a reddening effect which is intrinsic in the stars and which is associated with the development of line emission. Further research on both theoretical and observational lines is desirable.

Fourth International Locust Conference

THE International Locust Conferences are held at intervals of two to three years in order to take stock of the progress made in anti-locust research in different countries and to discuss the plans for further concerted action. The Fourth Conference took place at Cairo two years ago, in April 1936, but a full account of its proceedings has appeared only recently*.



SPREAD OF THE AFRICAN MIGRATORY LOCUST

The outbreak originated in 1928 in areas marked by two spots in zone 1, which was invaded during the first year. Zones 2, 3, 4, etc., represent the expansion of the invasion in each of the following years up to 1934. Arrows indicate the main directions of migration.

The Conference proved the world-wide interest in the locust problem, since twenty-three countries were represented (as against thirteen which took part in the Third Conference held in London in 1934), and more than fifty communications were made. The statistical data on the losses caused by locusts in some of the countries were of great interest; the United States reported losses during the ten year period 1925–34 amounting to about 245 million dollars, and Canada to about 36 millions, while more than 4·5 millions were spent on control in the first-named country, and nearly 3·5 millions in the second. Even more staggering figures were presented by the Union of South Africa, where two years of invasion by the red locust cost the country £943,500. Similar statistics collected for all countries suffering from locusts would undoubtedly show that this pest well deserves the attention recently paid to devising better means of controlling it. The Conference entrusted the Imperial Institute of Entomology with the regular collection of such statistical data in future.

The central problem discussed by the Conference was that of the recent progress in the study of the phases in locusts and its practical application. It was agreed that the phenomenon of phase transformation provides a trustworthy basis on which to frame a sound policy for the prevention of outbreaks of locusts and grasshoppers. With regard to the African migratory locust (*Locusta migratoria migratorioides* R. and F.), the data obtained as the result of international investigations centred at the Imperial Institute of Entomology were particularly convincing since the present invasion has been shown to originate in very restricted areas in the inundation zone of the Middle Niger, in the French Sudan. This happened about the year 1928, and in seven years nearly the whole of tropical Africa was overrun by swarms, as is shown in the accompanying map. This evidence induced the Conference to recommend to the Governments of the countries concerned to enter into discussion on the ways and means for the establishment of a permanent organization for the prevention of invasions of this locust in future, by keeping its outbreak areas under expert supervision and by suppressing all incipient swarms. A similar state of affairs was found to exist with regard to the two other African locusts, the red locust (*Nomadacris septemfasciata* Serv.) and the desert locust (*Schistocerca gregaria* Forsk.), although the investigations on these species were at that time not sufficiently advanced for practical steps to be taken.

Another outstanding event of the Cairo Conference was the discussion of the problem as to what extent such activities as agriculture and grazing affect the distribution and mass appearance of locusts and grasshoppers. It was commonly believed, even by some entomologists, that these insects constitute a danger only in the countries with a low level of agriculture, and that their outbreaks become less severe as the country is more highly developed. The evidence presented, particularly by the delegates from North America, led the Conference to the conclusion that, on the contrary, in the case of many species of locusts and grasshoppers, their excessive multiplication and spread have been furthered rather

* Proceedings of the Fourth International Locust Conference, Cairo, April 22, 1936. Pp. 96 + 51 appendixes. (Cairo: Government Press, 1937.)

than hindered by man's activities. Therefore, no hope can be entertained for the locust and grasshopper problem becoming less acute merely as a result of a general development of a country. The Conference suggested that particular attention should be paid in all future investigations to the influence on the life and ecology of locusts and grasshoppers of the various forms of human activity, such as agriculture, pastoral activity, deforestation, grass fires, etc.

All the aspects of the general theory of locust outbreaks, and most of the regional problems were discussed by the Conference, which embodied the results of discussions in twenty-five resolutions and four recommendations, based on the facts presented in the papers printed as appendixes to the proceedings, forming a large volume of nearly 500 pages.

The next, the Fifth International Locust Conference, will be held at Brussels in August this year.

B. P. U.

Numerical Changes in the German Student Body

By Dr. E. Y. Hartshorne, jun., Tutor in Sociology, Harvard University

OFFICIAL figures for the student body in the German Reich are available up to and including the academic year 1936–37. Frequent alteration in methods of classification and description have obscured the nature of some of the changes and make it difficult and sometimes impossible to interpret them. Only the less equivocal figures are here discussed. For the academic years 1932–33, 1933–34 and 1934–35, these are taken from the official *Deutsche Hochschulstatistik*, vols. 10–14; for 1935–36 from the official *Die Deutschen Hochschulen* vol. 1 (vol. 2 for 1936–37 either has not appeared or is inaccessible in the United States and Great Britain); for 1936–37 from the *Statistisches Jahrbuch für das Deutsche Reich* of 1937. There is reason to believe that the tendencies described below have continued in the academic year 1937–38.

In what follows there are included as 'students' all registered as such, except (*a*) 'auditors', that is those not committed to any definite course or examination, and (*b*) foreign students, except where specially indicated.

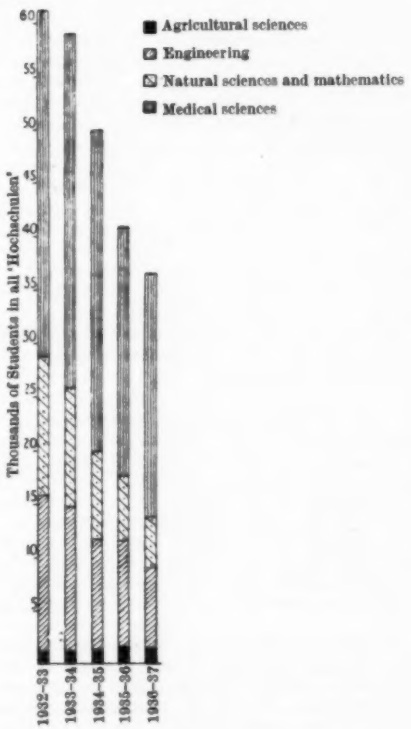
The decrease in the number of students is largely, but not entirely, conditioned by National Socialist policy. There are three obvious factors which have produced a fall in numbers. First, the number of young men in the German population of an age to enter the universities has probably fallen somewhat during these years. Secondly, since 1934 a limit has been set to the numbers admissible to a university education. Thirdly, Jews and so-called 'non-Aryans' have been practically excluded and the proportion of women students has been nominally fixed. The decrease, however, has been much sharper than can be explained by the action of these factors alone.

TABLE 1. NUMBERS OF STUDENTS IN ALL GERMAN *Hochschulen*: (UNIVERSITIES, COLLEGES OF ENGINEERING, MINING AND AGRICULTURE, AND SCHOOLS FOR TEACHERS AND FOR CATHOLIC THEOLOGY)

Winter Term	Men	Women	Both
1932–33	97,576	18,578	116,154
1933–34	91,263	15,501	106,764
1934–35	76,961	12,132	89,093
1935–36	70,462	10,976	81,438
1936–37	57,672	9,410	67,082

Thus in the winter term of 1936–37 the total number of students was only 57·8 per cent of the number enrolled before the National Socialist seizure of power in 1933. "Coming events cast their shadows before" since in the academic year 1932–33 this decline had already begun.

In the field of science, the accompanying graph shows the development of enrolment for the major groups: (1) agriculture, (2) engineering, (3) natural sciences with mathematics, and (4) medical sciences.* The sharp decline of entry in the last three of these practical fields is puzzling. It is easily intelligible that the National Socialist emphasis on



increased production from native soil should have raised the number in the agricultural sciences (1,356 in 1932–33 to 1,477 in 1936–37) and also have raised the proportion of students of agriculture to the total entry of students (from 1·2 to 2·2 per cent).

* In the category of medical sciences are here included dentistry, veterinary surgery and pharmacy.

The numbers here involved are small. But it will surprise most readers that there should be a loss, both absolute and relative, in the number of students in the great departments of engineering and of the natural sciences. The number of students in certain science subjects are given in Table 2.

TABLE 2. STUDENTS OF SCIENCES OTHER THAN MEDICAL

Winter Term	Engineering	Mathematics with Natural Sciences	Chemistry only
1932–33	14,477	12,951	3,543
1933–34	13,452	10,852	3,504
1934–35	10,310	7,943	3,006
1935–36	9,293	6,493	2,696
1936–37	7,649	4,616	2,058
Percentage change (1932–33 = 100)	52·9	35·6	58·0

Rearmament has naturally increased opportunities for the employment of highly-trained engineers, chemists, etc. Nevertheless, the flight from university education in these subjects is unmistakable. There are no reliable statistics to show the extent to which the great engineering and chemical concerns are training men on their own account and thus replacing the universities but, for certain departments of science, it is difficult to believe that they can provide courses that are adequate substitutes for those in universities. The greater part of the loss in numbers in these subjects, as in the general student body, is probably related to the more numerous and more tempting opportunities and the greater prestige of the expanding fighting services.

A peculiar position is occupied by the medical sciences. These show a large relative increase, though a considerable absolute fall, in the enrolment. While the total number of students in all fields fell in 1936–37 to 57·8 per cent of the number in 1932–33, in the medical field it fell only to 70·2 per cent. In 1932–33, of every hundred students, 27·9 were entered for medical courses. By 1936–37 the percentage of medical students had risen to 33·9 of the whole student body, as shown in Table 3. The factors at the back of these changes are complex and would need special discussion.

TABLE 3. STUDENTS ON MEDICAL SCIENCES

Winter Term	Total	Percentage of Whole Student Body
1932–33	32,437	27·9
1933–34	33,482	—
1934–35	30,123	—
1935–36	28,383	—
1936–37	22,797	33·9
Percentage change (1932–33 = 100)	70·2	

Unexpected results are yielded by the subjects of 'race science' and pre-history, on which very great emphasis is laid in schools and in the general educational system. So far as the universities are concerned, these special fields have neither enlisted more than a very small number of native students nor have they attracted any foreign students. For "Vorgeschichte" there were only 59 native and no foreign students, and for "Rassenkunde" there were only 47 natives and one foreign student in 1934–35. After that academic year the numbers of students for these subjects disappear from the available statistics.

In fields other than those of the sciences we note the changes shown in Table 4.

TABLE 4. STUDENTS IN NON-SCIENTIFIC FIELDS

	1932–33	1936–37	Percentage of 1932–33 enrolment
Ancient languages ..	1,225	307	25·1
Modern languages ..	3,589	842	23·4
'Germanistik'	3,636	1,540	42·4
Architecture	2,378	1,120	47·1
Journalism	208	353	169·7
Catholic theology ..	4,208	4,775	113·5
Protestant theology ..	6,588	2,583	39·2
Education	5,831	8,317	142·5

In 'Education' the number of women is practically stationary. The increase in that department has been almost entirely of men. It is perhaps explained by the need for 'leaders' in various youth movements.

Foreign students are numerically unimportant though they are significant in other ways. The numbers of foreign students have been fairly maintained for agriculture (97·5 per cent) and chemistry (94·3 per cent). There have been moderate falls in engineering (to 86·2 per cent) and architecture (to 80·3 per cent). There are much greater falls in law and social sciences (to 65·6 per cent), medicine (to 55·2 per cent), ancient languages (to 42·6 per cent) and 'Education' (to so low as 12·7 per cent). The fall in the total number of foreign students is from 6,693 in 1932–33 to 4,768 in 1936–37. The latter figure is 71·4 per cent of the former which is less change than might perhaps have been anticipated. The published figures do not permit us to determine the countries of origin of foreign students. We can say, however, that there has been a significant fall in English-speaking American students (from 817 to 418, that is, to 51·1 per cent) and a significant rise in Spanish- and Portuguese-speaking American students (from 102 to 165, that is, to 161·8 per cent).

Of all the major fields the greatest absolute loss has been in law and the social sciences. Yet despite this loss the Nationalist Socialist interpretation of these subjects is attracting the attention of certain foreign students as the figures in Table 5 show:

TABLE 5. STUDENTS OF LAW AND SOCIAL SCIENCES.

Winter Term	German Reich Students	Foreign Students
1932–33	24,161	1070
1933–34	20,363	669
1934–35	15,291	621
1935–36	12,617	651
1936–37	9,680	702
Percentage change (1932–33 = 100)	40·1	65·6

On the other hand, for medicine, Germany is ceasing to attract foreign students as is revealed in Table 6.

TABLE 6. FOREIGN STUDENTS OF MEDICAL SCIENCES

Winter Term	German Reich Students	Foreign Students
1932–33	32,437	1977
1933–34	33,482	1249
1934–35	30,123	1196
1935–36	28,383	1172
1936–37	22,797	1090
Percentage change (1932–33 = 100)	70·2	55·2

The Constitution of Starch

THE chemical structure of starch has not yet been fully elucidated. In recent years, evidence as to the size of its molecule has been derived from a study of the products obtained when trimethyl-starch is broken down; and it is supposed that, like cellulose, starch consists of chains of glucopyranose residues, but united by α-glucosidic instead of β-glucosidic links. Haworth has calculated that the molecule of starch consists of not more than 25–30 glucose units and that these units are associated into physical aggregates of much larger dimensions. On the other hand, Prof. Staudinger has long held the view that the physical properties of starch point to the existence of macro-molecules as distinct from molecular aggregates and in the May issue of the *Berichte der deutschen chemischen Gesellschaft* he and Herr Husemann adduce fresh evidence in support of this view from a study of the effect of chemical reactions upon the degree of polymerization of various preparations of starch from wheat.

The persistence of a particular degree of polymerization, after the starch had been regenerated from an acetylated derivative, has been clearly demonstrated and is held to be conclusive proof of the existence of macro-molecules. The reason why such evidence has not hitherto been available is because these macro-molecules are far more sensitive than ordinary molecules to disruptive agencies and it has been shown that even traces of atmospheric oxygen in the solvent exert an enormous effect upon the degree of polymerization.

The starch was first freed from phosphoric acid and purified by repeated precipitation by methanol from solution in formamide. Osmotic pressure measurements of a solution of this in formamide indicated a molecular weight of 286,000 or a polymerization degree of 1770. Another preparation with a polymerization degree of only 600 was obtained from it by rapid hydrolysis with normal hydrochloric acid. The two preparations were then acetylated, the former giving an insoluble, the latter a soluble, derivative. The acetylated compounds were then hydrolyzed by sodium methylate under very stringent conditions, when it was found that the polymerization of the regenerated starches had only been reduced to 1640 and 530 respectively. In view of the difficulty of eliminating the last traces of atmospheric oxygen during the alkaline hydrolysis, it is claimed that the degree of polymerization of the starch was materially unaltered by the process of acetylation. Viscosity measurements led to the same conclusion.

Starch appears to be not one compound but a kind of polymeric series. From the relation between degree of polymerization and specific viscosity the macro-molecules of starch must be quite different in structure from the micelles of cellulose for the viscosity of the latter is 5–10 times as great as that of starch of the same degree of polymerization. Since, however, the viscosity of the solution may be taken as a measure of the length of the dissolved molecules, those of starch must be very much shorter and are therefore coiled. It is also suggested that the coils are branched and the ends of the short glucose chains are linked in glucosidic fashion with hydroxyl groups of other chains. This structure would not only account for a relatively high proportion of tetra-methyl glucose among the fission-products of trimethyl starch but also for the complete absence of aldehydic properties in starch itself.

River Tees Survey

THE beauty and purity of our rivers is a national heritage, and the increasing attention that is being turned towards problems of pollution is therefore welcome. But before the causes and effects of pollution can be truly understood it is necessary to have, as a foundation, a knowledge of the natural, unpolluted state. One of the most important British contributions in this respect is to be found in a recent publication of the Water Pollution Board of the Department of Scientific and Industrial Research*. This report is concerned with the non-tidal reaches of the River Tees and supplements the work on the tidal region previously published. The survey was undertaken by the Ministry of Agriculture and Fisheries, the research staff being under the direction of Dr. E. S. Russell. The report is drafted by Dr. R. W. Butcher, Dr. J. Longwell and Mr. F. T. K. Pentelow, who were botanist, chemist and zoologist, respectively, on the survey.

A comprehensive chemical and biological survey was made and many experiments performed in the laboratory on the effects of sewage pollution. It was found that the River Tees could conveniently be divided into two regions, namely, from the source at Cross Fell to the junction with the River Skerne at Croft Bridge, a river mileage of 55 miles, and from Croft Bridge to Yarm, a distance of 24 miles. Above the junction with the Skerne, the Tees waters are fairly soft, and slightly alkaline, except at periods of heavy flood. The flora and fauna in this region are uniform, taking into consideration differences to be expected from type of bottom and rate of flow. The only pollution comes from several small sewage works between Middleton-in-Teesdale and Croft, but the dilution by the river is sufficiently great to prevent harmful effects.

The River Skerne is, however, quite different; its water is very hard and it is heavily polluted with sewage effluent from Darlington. The Skerne water on entering the River Tees produces a marked change in the chemical and biological characteristics of this lower reach. The hardness of the water is increased, as is also the amount of organic matter in solution and in suspension, with a resultant lowering of the oxygen content. The composition of the flora and fauna is different from that above Croft Bridge, but owing to the presence of nutritive substances from the sewage effluent the numbers of plants and animals are greater. By comparing the two regions

* Department of Scientific and Industrial Research. Water Pollution Research Technical Paper No. 6. Survey of the River Tees. Part 3. The Non-Tidal Reaches—Chemical and Biological. By R. W. Butcher, J. Longwell, and F. T. K. Pentelow. (London: H.M. Stationery Office, 1937.) 12s. 6d. net.

of the Tees it was possible to discriminate certain organisms as useful indicators of pollution.

The work opens up a number of questions, not only of economic importance but also of direct scientific interest. One of the most noteworthy points disclosed is our complete lack of knowledge concerning the life-histories of so many of those insects which form the major constituents in the food of trout and other fish. It was found impossible to identify many of the larval stages as these have never been described. The necessity for a comprehensive survey of this subject is stressed.

The Study of Genetics

ON three occasions recently the Indian journal *Current Science* has appeared as a special issue devoted to a particular topic. The third of these, dated March 1938, is devoted to genetics. It includes eight short reviews by acknowledged authorities, held together by an introduction by Dr. Eileen W. E. Macfarlane.

Dr. H. J. Muller writes on "The Present Status of the Mutation Theory", discussing the nature and the mode of action of the gene. The following section headings indicate the scope of his contribution: the gene as the material basis of mutation; the quantitative study of the normal mutation frequency; thermal and chemical influences on the mutation process; the production of mutations by irradiation; effects of mutations on the organism; changes in gene arrangement; and gene mutations as the primary steps of evolution.

Prof. O. Winge gives a very concise and clear review of the facts concerning the cytology of sex. He describes his own experiments on *Lebistes* in some detail in order to support his opinion that sex genes are present in all chromosomes and that there is always the possibility that the sex chromosome may become changed into an autosome and *vice versa*.

Prof. Kihara provides a short article on cytogenetics of species hybrids, whilst Dr. H. B. Frost, in an article on the genetics and cytology of citrus, furnishes a valuable example of the application of these disciplines to the study of a special group of economic value.

Special aspects of evolution are dealt with in the contributions by Prof. E. B. Babcock on phylogeny in the light of genetics and cytology and by Prof. A. F. Shull on adaptation in the light of genetics. The former stresses the importance of genetics, and particularly of comparative cytology, in discussions concerning phylogenetic relationships between groups of animals and plants, and illustrates his views with references to data from his and his co-workers' researches on the genus *Crepis*. Prof. Shull discusses the possible ways in which adaptation may have arisen through the interplay of mutation and selection, and suggests the lines which future work might profitably take when the problems of selection are being studied genetically.

Dr. C. B. Davenport in his "Genetics of Human Inter-racial Hybrids" stresses the importance of studies of this kind in regions where hybridization is just beginning, so that the first and second hybrid generations may be definitely known. He suggests that the regions where such studies might be profitably made are the Amoor River region in Siberia where the Siberians are coming into contact with the Japanese, in certain regions in Africa where the whites are meeting the practically full-blooded Negro stock, and in North America where the Eskimo and the white are now newly meeting.

The final article is by Dr. C. B. Bridges, who discusses in a most attractive way the future of genetics. He is of opinion that the near future will see genetical studies extended to an ever-increasing number of animal and plant forms; the intensive study of such forms as have so far failed to conform to established genetic principles, such studies leading to the consequent extension of those principles and to the invention of new hypotheses and the simplification of the old; the elaboration of new technical methods in genetic experimentation and in cytology; the employment of further physical or chemical and environmental agencies in the induction of cytogenetic novelty; the hybridization of genetics and cytology with other sciences such as chemistry, embryology, physiology; and finally, the progressive clarification of man's philosophical outlook as to his origin, development and activities, with the rescue of still other departments of life from the deistic and vitalistic to the naturalistic and mechanistic realms.

Dr. Bridges recommends studies of bacteria and viruses and phages for an understanding of gene action and of the nature of sex, and points out that the gene now occupies for us the place held by the cell for a previous generation of biologists. The gene must be analysed in terms of its physical structure and chemical behaviour. For the moment we think of it as a crystalline body, probably of the fibre type, the autocatalytic growth of which is by surface condensation of constituent simpler materials from the surrounding medium, and its reproduction is pictured as a simple split of this fibrous crystal when its growth has exceeded the size limits proper to its internal bonding *versus* the disruption due to temperature and other environmental factors. The model of gene structure must allow not only of autocatalytic growth and self-reproduction, but also of compositional change and the subsequent perpetuation of that new structure. On the hypothesis that the fields of force on the surface of the gene control its crystalline growth, it is conceivable that rare acceptance of a misfit building block would alter the surface material. The interpretation of 'position effects' will probably follow the idea that the action of the gene is limited by materials which diffuse into it. The induction of changes in the gene and in the chromosome by the use of radiations and of chemical agents is now only just begun. By their extended use, problems of the size, number, structure, mutability and action of the gene have become soluble. The cytologists may be expected to continue and elaborate their studies of the salivary gland chromosomes, and will proceed intensively to study the phenomena involved in the synapsis, crossing-over and distribution of chromosomes to the gametes.

Reading these articles, one cannot but be impressed by the extraordinary activity that is everywhere present in the field of genetics, by the luxuriance of its growth, and especially by its promise of great adventure.

Science News a Century Ago

Jenner and John Hunter

IN 1838, Dr. John Baron (1786–1851), the founder of the Medical Benevolent Society, published his book "The Life of Edward Jenner, M.D., etc." Jenner, who was born in 1749 and died in 1823, was a pupil of John Hunter, and in the course of a review of Baron's biography of him contained in the *Athenæum* of July 28, 1838, the reviewer said: "Between Hunter and his favourite pupil, there was much in common. Jenner was a full participator in his master's views, and Hunter acknowledged in him a kindred genius. Their correspondence in after-life was active; and Jenner continued his assistance in the labours of the school by observations, experiments and original speculations, directed to the development of its favourite objects. Trained under such a chief, and possessing an equally ardent love of nature, it is not to be doubted, that in whatever circumstances of professional life Jenner had been thrown, he would have made for himself a great name in science; and had he accepted a proposal which was made to him, to join Hunter in the business of lecturing, he could not but have become more favourably known to the medical world than he was as the provincial practitioner and discoverer of vaccination".

Differences between Pears and Apples

"A LONG and interesting memoir has been presented by M. Turpin to the French Academy of Sciences", said the *Athenæum* of July 28, 1838, "on the difference which exists between the cellular tissues of the apple and pear, which observations are expected to extend to knots of wood, to ligneous kernels, to the calcareous concretions found in the mantle of the Arions, and to the ossification of animals in general. Those authors most tenacious concerning the establishment of these two vegetables as different genera, have drawn their characters from the adherence of the lower part of the fine styles, to their villosity, to the speroid form of the fruit, and to the stalk being set in a cavity; characters which are frequently effaced. M. Turpin founds his on the absence or presence of those stony concretions which are met with in the cellular tissue of the pear".

Medicine in Holland

THE issue of the *British and Foreign Medical Review* of July 1838, No. 3, contains the following information: "Holland contains three universities: those of Leyden, Utrecht and Groningen. Harderwyke and Franecker were formerly the seats of universities, but owing to the small number of students at each were disfranchised early in the present century. Linnæus for some time studied, and ultimately graduated at Harderwyke; and here were published his *Amoenitates Anatomicae*. There are also three subsidised colleges or Athenæums, one at Amsterdam, another at Franecken, and the third at Deventer. Each of these has five faculties; and the medical faculties are subject to arrangements in accordance with the general system of instruction established in Holland. . . . Owing to its contracted territory and its intimate connexion with other centres, of which the languages are more generally studied and more extensively known, and from which, particularly Germany and France, books are continually imported, the medical literature of Holland is at present rather circumscribed".

University Events

BIRMINGHAM.—The following candidates have been awarded the degree of D.Sc.: F. W. Norris, for contributions to the *Biochemical Journal* on "The Pectic Substances of Plants", "Studies on Hemicelluloses", "Analysis of Carbohydrates of the Cell Wall of Plants", and other papers; L. F. C. Northcott, for various papers on the structure of metals and alloys in the *Journal of the Institute of Metals*, *Journal of the Iron and Steel Institute*, publications of the British Cast Iron Research Association, and elsewhere; E. Preston, for papers on "Viscosity of the Soda Silicate Glasses at High Temperatures and its Bearing on their Constitution" in the *Journal of Glass Technology*, "Evaporation and Diffusion of Volatile Material into an Inert Gas Stream" in the *Transactions of the Faraday Society*, and other papers on the technology of glass.

EDINBURGH.—Sir Arthur Olver has been appointed principal of the Royal (Dick) Veterinary College, Edinburgh (now affiliated with the University) in succession to the late Principal O. Charnock Bradley who died in November 1937. Sir Arthur graduated at the London Veterinary College in 1897 and obtained his fellowship in 1909. He served in the South African War, in Egypt and in the Sudan, in 1907. In 1908, he was appointed assistant director-general, Army Veterinary Services, and served throughout the Great War. In 1928–30 he was deputy director of veterinary services for India and in 1930 was appointed to the Imperial Council of Agricultural Research of India, from which post he has but recently retired. In his last positions he was largely responsible for the reorganization of the veterinary colleges and of veterinary research in India.

LONDON.—University postgraduate travelling studentships of the value of £275 for one year have been awarded to Margaret Elizabeth Broughton (King's College), and Mr. Edward Michael Evans (Imperial College—Royal College of Science). Miss Broughton proposes to visit Nigeria and make a study of the land use and native agriculture in the Lower Niger Basin. Mr. Evans proposes to investigate, under Prof. Bonhoeffer in the University of Leipzig, the synthesis of the sugars under the action of light, and in the presence of various catalysts.

University postgraduate studentships of the value of £150 for one year have been awarded among others to R. J. Bray, botany (Imperial College); V. C. E. Burnop, chemistry (Imperial College); M. G. Church, chemistry (University College); Elizabeth H. McPherson, philosophy (University College); W. H. Ward, engineering (Imperial College—City and Guilds Engineering College).

ST. ANDREWS.—The Court has agreed to accept the legacy by the late Miss Scott Lang on the conditions attached to that legacy, and has approved a scheme for the erection at the United College of an astronomical observatory and for the appointment of a lecturer in astronomy in fulfilment of these conditions.

Dr. C. A. Coulson, fellow of Trinity College, Cambridge, has been appointed lecturer in mathematics in University College, Dundee.

Societies and Academies

Dublin

Royal Irish Academy, June 13.

J. J. NOLAN and P. J. NOLAN: Diffusion and fall of atmospheric condensation nuclei (with an appendix by P. G. Gormley). Recalculation of results obtained previously by Nolan and Guerrini give for the diffusion coefficients of nuclei, held during the experiment in a water-sealed gasometer, the value $D = 12 \times 10^{-4}$ cm.²/sec. New experiments with nuclei held in an oil-sealed gasometer give $D = 20 \times 10^{-4}$ cm.²/sec. The values of the radii of the nuclei deduced from these results are 3·55 and $2{\cdot}68 \times 10^{-6}$ cm. respectively.

DOROTHY HILL and L. B. SMYTH: The identity of *Monilopora* (Nicholson and Ethridge, 1879) with *Cladochonus* (McCoy, 1847). The genolectotype of *Cladochonus* McCoy, 1847, is *C. tenuicollis* McCoy. The type specimen of this, from the Carboniferous of New South Wales, has been sectioned, and is here figured and described. The types of *C. bacillarius* M'Coy and *C. crassus* M'Coy are from the Carboniferous of Co. Donegal, Ireland. The latter species was made the type of *Monilopora* Nich. and Eth., 1879, the distinguishing features being the unique reticulate tissue, and the attachment to a crinoid columnal. Work on new material from Doorin Point, halfway between the two type localities, has revealed: (*a*) that *C. bacillarius* and *C.* (*Monilopora*) *crassus* are parts of the same organism, the upright zig-zag *bacillarius* phase arising from the creeping ring-like *crassus* phase; (*b*) that the reticulate tissue occurs in the calice wall of both; (*c*) that the *crassus* phase is not confined to a crinoid stem as a support, a specimen having been found attached to a bryozoan, and several with an empty ring. The reconstructed organism is assigned to *Cladochonus*; *Monilopora* is discarded and *crassus* is chosen as the specific name.

Paris

Academy of Sciences, June 8 (*C.R.*, 206, 689–1768).

ELIE CARTAN: Generalized spaces and the integration of certain classes of differential equations.

HENRI DEVAUX and LOUIS PALLU: A macroscopic representation of monomolecular films and their behaviour in various states of compression. Description of experiments on the distribution of rape seed on the surface of a sheet of mercury. The results confirm the generally admitted interpretation of the arrangement of the molecules in monomolecular layers.

MARC KRASNER: A generalization of the local theory of bodies of classes. Value of the conductor. Interpretation of a formula of Artin. Law of limitation for Galoisian extensions.

PAUL LÉVY: Correction to a previous note.

TH. MOTZKIN: Plane arcs, the osculating curves of which do not cut.

NICOLAS BOURBAKI: Banach spaces.

HEINRICH BEHNKE and KARL STEIN: Convergent suites of domains of holomorphy.

HENRI PAILLOUX: The equilibrium of certain deformable membranes.

LÉOPOLD ESCANDE: New experimental researches on flow through a submerged valve gate.

J. GÉHÉNIAU: Study of the interaction between a photon and an electron, by wave mechanics.

MME. MARIE ANTOINETTE TONNELAT-BAUDOT: The equation of propagation of the photon in a non-Euclidian space.

MAURICE BAYEN: Measurement of the dispersion of the ultra-violet refraction of heavy water.

MAURICE PARODI: The vibrations of some fluorine compounds.

JEAN ROUVILLOIS and HENRI MURAOUR: The study of the transformation of a band spectrum into a continuous spectrum under the influence of pressure.

PIERRE AUGER, RAYMOND MAZE and MME. THÉRÈSE GRIVET-MEYER: Large atmospheric cosmic sprays containing ultra-penetrating corpuscles.

HENRI MURAOUR and GABRIEL AUNIS: Verification of the law of combustion by parallel layers for colloidal powders.

ENRIQUE MOLES, MLLE. T. TORAL and A. ESCRIBANO: The limiting density of the gas SO_2. The atomic weight of sulphur. The mean figure for the normal density was 2·92655, giving 2·85794 as the limiting density. From this, the atomic weight of sulphur is deduced as 32·062.

THADÉE PECZALSKI: The sublimation and mutual diffusion of salts and of metals.

MARCUS BRUTZCUS: The theory of heterogeneous catalysis.

ANDRÉ BOULLÉ: Sodium tetrametaphosphate.

MLLE. FRANCE BLOCH: The constitution of the thioacids. From a study of the absorption spectrum in the infra-red it is concluded that if thioacetic acid is a mixture of the two tautomeric forms, $CH_3.CO.SH$ and $CH_3.CS.OH$, the amount of the latter form is very small.

Z. CHARLES GLACET and JOSEPH WIEMANN: Duplicative reductions.

ALFRED SILBERSTEIN: The crystalline structure of ammonium cupridiammoniotetrachloride.

GILBERT MATHIEU: Discovery of an Ordovician fauna in the synclinal of Saint-Pierre-du-Chemin (Vendée).

PIERRE COMTE: The upper Famennian in the Cantabrian Cordillera.

ANDRÉ CAILLEUX: Pebbles shaped by the wind in the Quaternary in the south of Brittany.

LOUIS BESSE: Experimental study of the velocity of fall of plane particles in a viscous medium. It is impossible to apply Stokes's law, even in a form embodying corrections, to non-spherical particles.

GEORGES DÉJARDIN and RENÉ BERNARD: The bands of the (OH) molecule in the spectrum of the night sky.

ANDRÉ RENAUD: A halo at the surface of snow.

PIERRE DANGEARD: The enumeration of the chromocentres in the quiescent or interphase nucleus.

J. RABATÉ and A. GOUREVITCH: The presence of *l*-tartaric acid in the leaves and fruits of *Bauhinia reticulata*. This is the first example of laevotartaric acid being extracted from a plant. The leaves or fruits yield 4–6 per cent of the pure acid.

OTTAVIO MUNERATI: The possibility of forcing beetroots to give stems outside the normal time.

PHILIPPE JOYET-LAVERGNE: The mechanism of the action of the X-rays on the cytoplasm of the cell.

MLLE. PAULETTE BERTHIER: The action of electrolytes on the surface tension of saponin solutions.

GEORGES MOURIQUAND, JACQUES ROLLET and MLLE. ADELA PAPE: Chronic A avitaminosis.

Amsterdam

Royal Netherlands Academy (*Proc.*, **41**, No. 5, 1938).

J. G. VAN DER CORPUT: Contribution to the additive theory of numbers (3).

R. WEITZENBÖCK: On trivectors (7).

E. COHEN and W. A. T. COHEN DE MEESTER: Acute tin plague. (2) The very great influence of small quantities of aluminium alloyed with tin on the rate of change of white tin into grey tin is closely connected with the effect of traces of water on such alloys as observed by Heyn and Wetzel.

P. P. BIJLAARD: A theory of plastic buckling with its application to geophysics.

A. ERDÉLYI: Some integral formulæ for Whittaker functions.

C. VISSER: The iteration of linear operators in a Hilbert space.

J. A. BARRAU: Generalizations of Steiner's Roman surface.

O. BOTTEMA: Families of quadratic varieties.

H. J. DE BOER: A period of 5·25 years in rainfall, temperature and pressure.

ANNA M. A. VAN SANTEN: Influence of hydrogen ion concentration on the growth rate of the *Avena* coleoptile. The curve representing the growth-rate of excised coleoptile sections of *Avena* in 0·01 molar phosphate buffer solutions as a function of *p*H coincides in part with the dissociation curve of auxin, indicating that the growth substance is only active in its undissociated acid form.

ONG SIAN GWAN: Exaltation and maintenance of the virulence, variation of the rate of agglutination, increase of the velocity of displacement and of propagation of *B. coli*.

Capetown

Royal Society of South Africa, May 18.

H. B. FANTHAM (the late): *Lecithostaphylus canthari*, n.sp., a trematode parasite of the hottentot fish, *Spondyliosoma blochii*, of South African waters.

E. H. ASHTON: A sociological sketch of Southern Sotho diet.

Moscow

Academy of Sciences (*C.R.*, **18**, No. 9, 1938).

M. KREIN: The best approximation of the continuous functions.

M. A. RUTMANN: A special class of wholly continuous linear operators.

L. S. GILMAN: Application of the conformic representation to the solution of a problem in the theory of elasticity.

P. A. WALTHER and W. A. STEFANOWSKI: Comparison between two axial pumps, one calculated according to the Joukowski theory, and the other according to that of the triangle of velocities.

J. A. ALPERT, V. V. MIGULIN and P. A. RIASIN: Dispersion of electro-magnetic waves above the earth's surface.

A. GORODEZKAYA and A. FRUMKIN: Investigation of thin layers of organic substances at the mercury/solution boundary by the method of capacity measurements. (1) High-molecular alcohols and acids.

ANNA GELMAN and M. BAUMAN: Compounds of platinum and carbon monoxide.

E. A. ŠILOV: Transmitting mechanisms of organic reactions.

V. S. BYKOVA: Quantitative separation of niobium and titanium.

V. S. BUTKEWITCH, E. MENZHINSKAIA and E. I. TROFIMOVA: Glucuronic acid as an intermediate phase in the formation of citric acid from sugar.

V. S. BUTKEWITCH: The question of intermediate phases of biochemical transformation of sugar into citric acid.

K. V. RADUGIN: The Salaïr folding.

B. M. KELLER: Eocene sediments of the Tuapse region.

D. S. BELIANKIN: Characteristics of the mineral 'monothermite'.

M. A. ROSANOVA: Polymorphic type of the origin of species.

H. F. KUSHNER: Composition of blood of camels in relation to their working ability.

B. A. ZENKOVIČ: The temperature of whales.

N. A. MANUILOVA: Lens-building power of the eye-cup in Amphibia as affected by repeated induction.

N. A. MANUILOVA, A. I. MACHABELI and T. A. SIKHARULIDZE: Investigation of the morphogenetic properties of the eye-cup in tail-less Amphibia.

Washington, D.C.

National Academy of Sciences (*Proc.*, **24**, 199–227; May 15, 1938).

G. A. MILLER: (1) Relative numbers of operators and subgroups of a finite group. (2) Minimum degree of substitutions of highest degree in a group.

C. E. BUCHWALD, D. M. GALLAGHER, C. P. HASKINS, E. M. THATCHER and P. A. ZAHL: Measurements of resistance and capacity of monofilms of barium stearate. For this purpose, a standard A.C. bridge (0·25 volt at 1000 cycles) was used, with one arm modified to allow preliminary balancing of the 'unfilmed' cell.

D. F. JONES: Translocation in relation to mosaic formation in maize.

R. D. GORDON: Estimating bacterial populations by the dilution method. Halvorson and Ziegler's tables, which give an estimate of the mean density of viable bacteria in the middle of three successive dilutions, using a dilution of 10 : 1 and three sets of ten test-tubes, are apparently based on Fisher's criterion of maximum likelihood. A better result is obtained by using the geometric mean, and appropriate formulæ are deduced.

W. J. CROZIER, E. WOLF and GERTRUD ZERRAHN-WOLF: (1) Temperature and the critical intensity for response to visual flicker. Experiments on the turtle indicate that the shape of the curve of flash frequency (F) against logarithm of the critical intensity for 'recognition' of flicker (I) is unaffected by change of temperature, the whole curve being shifted to lower intensities with rise of temperature. It is suggested that recognition of flicker is governed by the velocity of a terminal reaction affecting several nervous elements, and that this reaction involves at least two steps of a catalytic nature. (2) Specific constants for visual excitation (ii). Experiments with albino teleosteans gave curves for F against log I which correspond exactly with those of normal fish of the same stock.

E. GUTH and A. E. HAAS: Relation between Stefan's radiation law, Nernst's heat theorem and Maxwell's formula for the radiation pressure.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

SENIOR LECTURER IN MECHANICAL ENGINEERING at the South-West Essex Technical College—The Clerk to the Governors, 263 High Street, Walthamstow, E.17, enclosing stamped addressed foolscap envelope (July 25).

LECTURER IN CIVIL ENGINEERING AND/OR BUILDING at the Chesterfield Technical College—The Clerk to the Governors, enclosing stamped addressed foolscap envelope (July 28).

AN ASSISTANT LECTURER IN APPLIED CHEMISTRY, with special reference to bleaching, dyeing and finishing, at University College, Nottingham—The Registrar (July 30).

INSPECTOR (male) in the Ministry of Agriculture and Fisheries for the purposes of the Diseases of Animals Acts, 1894–1935—The Secretary of the Ministry, 10 Whitehall Place, S.W.1 (August 2).

ASSISTANT LECTURER IN HORTICULTURE at the East Anglian Institute of Agriculture, Chelmsford—The Clerk of the County Council, County Hall, Chelmsford (August 3).

TWO ENGINEERING INSPECTORS in the Ministry of Health, one with experience of sewage disposal works—The Director of Establishments, Ministry of Health, Whitehall, S.W.1 (August 8).

ASSISTANT LECTURER IN METALLURGY at the University College of Swansea—The Registrar (September 10).

PROFESSOR OF INORGANIC AND PHYSICAL CHEMISTRY in the Egyptian University—The Dean, Faculty of Science, Abbassia, Cairo (September 15).

JUNIOR ASSISTANT in the Development Department British Non-Ferrous Metals Research Association—The Secretary, B.N.F.M.R.A., Regnart Buildings, Euston Street, N.W.1.

EVENING TEACHERS FOR ELECTRICAL ENGINEERING, INSTALLATION, RADIO, ACOUSTICS, LIGHT AND ELECTRICITY at the Borough Polytechnic, London, S.E.1—The Principal.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Committee of the Privy Council for the Organisation and Development of Agricultural Research. Report of the Agricultural Research Council for the Period October 1935–September 1937. (Cmd. 5768.) Pp. vi+378. (London: H.M. Stationery Office.) 5*s*. 6*d*. net. [117

Federal Council of Lancashire and Cheshire Teachers' Associations. Report on Entry into Employment. Pp. 12. (Manchester: Federal Council of Lancashire and Cheshire Teachers' Associations.) [117

National Union of Teachers. Junior Technical Schools: Memoranda on Pamphlets 111 and 113 of the Board of Education. Pp. 32. (London: National Union of Teachers.) [117

King's College, Newcastle-upon-Tyne: Standing Committee for Research. Report, Session 1936–1937. Pp. 45. (Newcastle-upon-Tyne: King's College.) [117

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1798 (3287): Galerkin's Method in Mechanics and Differential Equations. By Prof. W. J. Duncan. Pp. 33. 4*s*. 6*d*. net. No. 1803 (3137): Visual and Photographic Methods of Studying Boundary Layer Flow. By Dr. H. C. H. Townend. Pp. 22+11 plates. 5*s*. 6*d*. net. No. 1808 (3257); The Determination of Drag by the Pitot Traverse Method. By G. I. Taylor. Pp. 10. 1*s*. 6*d*. net. No. 1814 (2827): Wind Tunnel Tests and Charts of Airscrews at Negative Thrust. By C. N. H. Lock, H. Bateman and H. L. Nixon. Pp. 20. 3*s*. net. No. 1818 (3105): An Approximate Method of Stressing the Struts of a Stiff-jointed Framework. By J. B. B. Owen and J. Taylor. Pp. 30. 4*s*. net. No. 1819 (2951): Full Scale Tests of Slotted Flaps and Ailerons on a Courier. By R. H. Francis. Pp. 20. 3*s*. net. No. 1821 (3163): A Review of some Full-scale Tests on Landing Flaps. By J. E. Serby. Pp. 17. 2*s*. 6*d*. net. No. 1823 (3013): Gust Loads on Tails and Wings. By D. Williams and J. Hanson. Pp. 39. 5*s*. 6*d*. net. No. 1824 (3321): Relaxation Methods applied to Grid Frameworks. By Derman Guy Christopherson. Pp. 12. 2*s*. net. No. 1828: Abstracts of Papers published externally. Pp. 20. 3*s*. net. (London: H.M. Stationery Office.) [117

Brief Guide to Government Publications. By F. R. Cowell. Pp. 44. (London: H.M. Stationery Office.) 3*d*. [127

London Shellac Research Bureau. Technical Paper No. 13: A New Process for Hard Lac Resin. By Dr. R. Bhattacharya and Dr. B. S. Gidvani. Pp. 21. Technical Paper No. 14: Modification of Lac with Higher Fatty Acids and their Mixed Glycerol Esters, Part 2. By Dr. R. Bhattacharya and Dr. B. S. Gidvani. Pp. 17. (London: London Shellac Research Bureau.) [127

Technical College, Bradford. Diploma and Special Day Courses, Session 1938–1939. Pp. 262+23 plates. (Bradford: Bradford Education Committee.) [127

Ministry of Health. First Report of the Central Advisory Water Committee. Underground Water; Planning of Water Resources and Supplies. Pp. 28. (London: H.M. Stationery Office.) 6*d*. net. [137

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